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NUCLEAR SCIENCE ABSTRACTS

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January 31, 1961

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NUCLEAR SCIENCE ABSTRACTS

Volume 15, Number 2
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GENERAL AND MISCELLANEOUS

1105 ANP-60(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 10, 1951. W. B. Cottrell, ed. June 19, 1951. Decl. with deletions Jan. 7, 1960. 262p. Contract W-7405-eng-26. OTS.

Progress is reported on the design of the 200 Mw Aircraft Reactor, design of the Aircraft Reactor Experiment, reactor physics, critical experiments, nuclear measurements, chemistry of liquid fuels, corrosion experimentation, liquid metal and heat transfer research, components of liquid metal systems, metallurgical processes, radiation damage homogeneous circulating-fuel and circulating-moderator reactors, vapor-cycle and helium-cycle systems, supercritical-water cycle, and supersonic tug-tow system. (W.L.H.)

1106 ITR-1405
Sandia Corp., Albuquerque, N. Mex.
GROUND MOTION STUDIES AT HIGH INCIDENT OVERPRESSURE. J. W. Wistor and W. R. Perret. Oct. 11, 1957. Decl. Aug. 31, 1960. 42p. Project 1.5 [of] OPERATION PLUMBBOB. OTS.

Measurements were made of vertical and radial accelerations and displacements produced in the ground by airshock following a 39 kt nuclear explosion at a burst height of approximately 700 ft. Instruments used in the study are described. Applications of the data in the design of protective shelters are discussed briefly. (C.H.)

1107 NP-9307
Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
QUARTERLY PROGRESS REPORT NO. 58. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann. July 15, 1960. 308p. Project No. 3-99-00-000. Contract DA36-039-sc-78108.

Research activities for the quarter ending May 31, 1960, are reviewed. Progress is indicated in the fields of physical electronics, plasma dynamics, solid-state physics, low-temperature physics, thermoelectric processes and materials, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, satellite time-dilation measurement, modulation theory and systems, statistical communication theory, process analysis and synthesis, processing and transmission of information, physical acoustics, speech communication, mechanical translation, communications biophysics, neurophysiology, circuit theory, network synthesis, linguistics, and medical electronics. (For preceding period see NP-8755.) (W.D.M.)

1108 ORNL-1771(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 10, 1954. A. W. Savolainen, ed. Oct. 29, 1954. Decl. with deletions Dec. 2, 1959. 152p. Contract W-7405-eng-26. OTS.

Progress is reported on the Circulating-fuel Aircraft Reactor Experiment, Reflector-moderated Reactor, experimental reactor engineering, critical experiments, chemistry of molten materials, corrosion research, metallurgy, heat transfer and physical properties, radiation damage, and analytical studies of reactor materials. (W.L.H.)

1109 ORNL-1896(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 10, 1955. A. W. Savolainen, ed. July 28, 1955. Decl. with deletions Nov. 13, 1959. 179p. OTS.

Progress is reported on the reflector-moderated reactor, experimental reactor engineering, critical experiments, chemistry of reactor materials, corrosion research, metallurgy and ceramics, heat transfer and physical properties, radiation damage, analytical chemistry of reactor materials, and recovery and reprocessing of reactor fuel. (W.L.H.)

1110 ORNL-2106(Pts.1-5)(Del.)
Oak Ridge National Lab., Tenn.
AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 10, 1956. A. W. Savolainen, ed. Sept. 4, 1956. Decl. with deletions Dec. 2, 1959. 257p. Contract W-7405-eng-26. OTS.

Progress is reported on the Aircraft Reactor Test (ART) design; ART physics; ART instruments and controls; component development and testing; ART, ETU, and in-pile loop operations; phase equilibrium studies; chemical reactions in molten salts; physical properties of molten materials; production of fuels; compatibility of materials at high temperatures; analytical chemistry; dynamic-corrosion studies; general-corrosion studies; fabrication research; wedling and brazing investigations; mechanical-properties studies; ceramic research; nondestructive-testing studies; heat transfer and physical properties; radiation damage; fuel recovery and processing; and critical experiments. (W.L.H.)

1111 SC-4824(RR)
Sandia Corp. Livermore Lab., Livermore, Calif.
HIGH EXPLOSIVES, ARMING AND FIRING, PROJECT HOBO. R. J. Tockey. Aug. 1960. 29p. OTS.

High-explosive procurement and emplacement for Hobo project are described. Arming and firing of the test devices are also described, and activities related to furnishing timing signals to all participants in the tests are reported. (J.R.D.)

1112 TID-6602
Holmes and Narver, Inc., Los Angeles.
COMPLETION REPORT — PROJECT PLOWBOY, PLOWSHARE PROGRAM. Sept. 1960. 33p. Contract AT(29-2)-20. (P/PL-2-60). OTS.

Project Plowboy was a postshot investigation of the fractured regions surrounding two detonation points in a salt formation of the Carey Salt property. The fracturing effects in the salt studied resulted from high-explosive detonations conducted during Project Cowboy. (W.L.H.)

1113 TID-7541(Pt.2)
Division of Nuclear Materials Management, AEC.
AEC AND CONTRACTOR SOURCE AND SPECIAL MATERIALS MANAGEMENT REPRESENTATIVES MEETING. A Conference Held at Washington, D. C., June 17-19, 1957. Dec. 1957. Decl. May 4, 1960. 76p. OTS.

Six papers are presented, covering a broad range of subjects that include accounting and auditing, measurements, and statistics in the control of SS materials. Separate abstracts have been prepared for each paper. (W.L.H.)

1114 TID-7541(Pt.2)(p.7-18)
National Lead Co. of Ohio, Cincinnati.
RECOVERY AND EVALUATION OF URANIUM RESIDUES AT THE FMPC SCRAP PROCESSING FACILITY. A. V. Soldano, C. H. Walden, and P. N. McCreery.

The normal uranium scrap recovery processes available at the Feed Materials Processing Center (FMPC) are described. By following a typical lot of uranium scrap material from the time it is received on the site through the stages of receiving, storage, processing, and content evaluation, the various ramifications of the conversion of uranium scrap material to refinery feed are presented. (auth)

1115 TID-7541(Pt.2)(p.19-30)
Oak Ridge National Lab., Tenn.
SS MATERIAL CONTROL PROBLEMS AT A RESEARCH INSTALLATION. H. F. Stringfield.

SS materials control problems at a large research and development facility are as diverse as the various programs and projects being undertaken. Material usages range from minute quantities (micrograms and milligrams) to multikilogram and ton quantities. Control of these varying quantities of materials requires special supplemental procedures. Uniform materials control regulations applicable to both production type of activities and to research and development activities are recognized as essential down to some heretofore undefined quantities. A survey conducted at the Oak Ridge National Laboratory during the past year focused attention on the thousands of specially prepared specimens containing small quantities of SS materials and on the problems confronting the researcher in accounting for the materials. The study suggested the need for defining a fixed minimum limit below which formal accountability would be eliminated. The addition of quarterly forecasting SS materials requirements for research and development poses several problems; these problems are discussed. (auth)

1116 TID-7541(Pt.2)(p.31-42)
National Lead Co. of Ohio, Cincinnati.
THE EFFECT OF THE MOISTURE DETERMINATION ON THE ASSAY OF URANIUM ORE CONCENTRATES. Dorothy Valent and Bernard Gessiness.

Moisture absorption or loss under random, uncontrolled conditions are universally variable. It is the accepted practice to "dry" samples of pitchblende and uranium concentrates at 110°C in order to establish a basis for reporting assays that is common to both vendor and buyer. Data are presented indicating that the "dry basis" value is questionable, depending on the fluctuation of atmospheric humidity during the drying operation. Examples for various types of concentrates are given; the effect on accountability is summarized. Alternate solutions to the moisture problem are suggested. (auth)

1117 TID-7541(Pt.2)(p.43-53)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
SPECIAL PROBLEMS IN ACCOUNTABILITY OF ENRICHED URANIUM. R. E. Olson.

A review of enriched uranium accountability procedures is presented for uranium-aluminum alloy fuel element cores. The choice of analytical method and statistical sampling plan is discussed with reference to cost, precision, equipment availability, and other pertinent factors. In-process losses and measurement practices for these losses are also included. (auth)

1118 TID-7541(Pt.2)(p.54-71)
National Lead Co. of Ohio, Cincinnati.
DERIVATION OF NET WEIGHTS BY FACTOR WEIGHT TECHNIQUES. Norman K. Smith and Alonzo Church, Jr.

The concept of utilizing a slug factor weight in lieu of 100% net weighing is presented. A method for obtaining such a factor by weighing a randomly selected sample of slugs is discussed. The sampling plans used and their effects on precision, bias, and over-all reliability of shipping weights are presented and the results compared to the results of a 100% net weighing procedure. (auth)

1119 TID-7541(Pt.2)(p.72-6)
Dow Chemical Co. Rocky Flats Plant, Denver
PLUTONIUM INVENTORY PROBLEMS. P. A. Kerwood.

Some of the problems of physically inventorying plutonium in the Rocky Flats fabrication plant are discussed. To give added meaning, the discussion includes a brief review of material balance areas, the batch card system, and inventory procedures with the highlights centered on the problems associated with a physical inventory. (auth)

1120 TID-8209
Office of Operations Analysis and Forecasting, AEC.
FOSSIL FUELS IN THE FUTURE. Milton F. Searl.
Oct. 1960. 66p. OTS.

A review of fossil-fuel resources is presented along with a forecast of the rate at which they will be depleted in the absence of new energy sources. Energy projections are included for the United States, other areas, and the world as a whole for the remainder of this century. (J.R.D.)

1121 T-126(RAND)
Akademiya Pedagogicheskikh Nauk RSFSR. Institut Psikhologii.
A COMPARISON OF THE THEORETICALLY POSSIBLE AND ACTUAL PROCEDURES USED IN PROBLEM SOLVING. A. H. Zakharov. Translated by Andrew Kozak.
[195?]. 21p.

The theoretically possible procedures of problem solving are compared with solutions obtained by subject personnel in experiments. Problems which can be solved by trial were selected for the comparison. (J.R.D.)

1122
THE IMPORTANCE OF STABLE ISOTOPES. J. Mühlenpfordt (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 816-22(1960) Sept. (In German)

Stable isotopes are becoming of increasing importance in research. Isotope composition variations in a series of chemical elements in nature have already become valuable

in geochemistry, geophysics, and geology. These variations are of concern also in physical, chemical, and biochemical processes. Examples of specific research applications are given. Isotope analysis, isotope separation, and tracer techniques developed for radioisotopes are useful with stable isotopes. (T.R.H.)

1123

THE SNAP PROGRAMME. U. S. AEC'S SPACE-ELECTRIC POWER PROGRAMME. Guveren M. Anderson and Frank H. Featherston. Nuclear Eng. 5, 460-3(1960) Oct.

Project SNAP, the program for developing electric-power-generating systems for space craft using radioisotope and fission reactor heat sources, is reviewed. SNAP-1 is used to designate the program for the development of a radioisotope-fueled space auxiliary power unit using Ce^{144}. This turbogenerator was developed and under testing operated in excess of specifications. SNAP-3, a program to develop advanced thermoelectric and thermionic conversion devices that could be used with radioisotope heat sources, resulted in a thermoelectric generator using Po^{210} fuel capsules. The SNAP-2 system uses a 50-kw(t) compact-core reactor employing liquid NaK as the coolant to transfer heat to a mercury loop to produce 3 kw in a high-speed-shaft unit. The complete system weighs approximately 600 lb and is designed for programed start-up in orbit. Two additional space power units (SNAP-8 and SNAP-10) were started, based on the metal hydride reactor technology of SNAP-2. (M.C.G.)

1124

SPACE RESEARCH. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960. Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. 1211p. $24.00. (In English and French)

The papers are divided into seven groups: the earth's atmosphere, the ionosphere, tracking and telemetering, solar radiation, cosmic radiation, interplanetary dust, and the moon and the planets. Fifteen papers are covered by separate abstracts. Four were previously abstracted for NSA. (M.C.G.)

1125

THE ISOTOPE INDEX. THE COMPLETE PURCHASING GUIDE TO THE ISOTOPES. STABLE–RADIOACTIVE LABELED COMPOUNDS. Vol. 4, No. 1, July 1959. J. L. Sommerville, ed. Indianapolis, Scientific Equipment Co., 1959. 124p. · $5.00(U. S. and Canada), $5.50(foreign).

The fourth edition of the Isotope Index includes the AEC licensing procedures; commercially available radioisotopes, stable isotopes, and labeled compounds with suppliers, activities, and prices; and isotope suppliers. Some of the radioisotopes listed are C^{14}, H^3, I^{131}, P^{32}, and S^{35}. (D.L.C.)

1126

United States. Congress. Joint Committee on Atomic Energy.

INDEMNITY AND REACTOR SAFETY. HEARINGS BEFORE THE SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT AND THE SPECIAL SUBCOMMITTEE ON RADIATION OF THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, EIGHTY-SIXTH CONGRESS, SECOND SESSION, APRIL 26 AND 27, 1960. PART 2. 1960. 197p. GPO.

Testimony is given on atomic energy indemnity problems and reactor and radiation safety, including site selection and the operations of the Advisory Committee on Reactor Safeguards. An appendix includes material on indemnification of licensees, indemnification of activities conducted under AEC contract, maritime indemnity problems—NS Savannah foreign acceptance agreements, foreign indemnity, and operations of the Advisory Committee on Reactor Safeguards. (T.R.H.)

1127

United States. Congress. Joint Committee on Atomic Energy.

REPORT TO THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES. VOLUME 1. REVIEW OF THE INTERNATIONAL ATOMIC POLICIES AND PROGRAMS OF THE UNITED STATES. VOLUMES 2, 3, 4, AND 5. BACKGROUND MATERIAL FOR THE REVIEW OF THE INTERNATIONAL ATOMIC POLICIES AND PROGRAMS OF THE UNITED STATES. Oct. 1960. 2249p. GPO.

The current status of the international policies and programs of the United States as they relate to the peaceful uses of atomic energy are appraised and evaluated in relation to their original premises and purposes. Courses of action which appear to be open to those responsible for the formulation and execution of atomic policies and programs for the future are explored. The review embraces United States relationships with industrialized and less-developed countries, with allied countries, and with Communist-dominated countries. While the review and evaluation are concerned with all geographic areas and all atomic applications, United States relationships with other nations of North America and Western Europe received the greatest attention. Topics discussed include the current and prospective status of civilian atomic power; other peaceful atomic applications; energy-resource estimates and energy-demand forecasts; and the evaluation of the international policies and programs of the United States in the peaceful atomic field. All the specially prepared reports, memoranda, and evaluation reports assembled and considered in the course of the review are included. (C.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

1128 A/AC.82/G/L.378

[Gt. Brit. Medical Research Council. Radiobiological Research Unit, Harwell, Berks, England].

BIBLIOGRAPHY OF PAPERS PUBLISHED IN THE UNITED KINGDOM FROM JANUARY 1959 TO MAY 1960 ON RADIOBIOLOGICAL AND ALLIED SUBJECTS. 12p. (MRC-60/735).

A bibliography of published literature between January 1959 and May 1960 is presented on natural and fall-out radioactivity in man, fission products in human bone and animal tissues, fission products in food chains, genetics, general radiobiology, leukemia, tumors, oxygen effect, tissue transplants, dose-rate effects, hematopoietic system, special tissues, RBE, life span, and chemical effects. (163 references). (T.R.H.)

1129 ANL-6200

Argonne National Lab., Ill.

BIOLOGICAL AND MEDICAL RESEARCH DIVISION SEMIANNUAL REPORT [FOR] JANUARY THROUGH JUNE 1959. Aug. 1960. 106p. Contract W-31-109-eng-38. OTS.

Separate abstracts were prepared on 25 sections of this report. A list of publications during the period is included. (C.H.)

1130 ANL-6200(p.9-12)
Argonne National Lab., Ill.
NUCLEAR STRUCTURES OBSERVED DURING DIVISION IN THE GIANT AMOEBA. L. E. Roth.

Nuclear structures during mitosis of the giant Amoeba, Pelomyxa carolinensis, as observed by electron microscopy, are described. (C.H.)

1131 ANL-6200(p.13-15)
Argonne National Lab., Ill.
OXIDATIVE PHOSPHORYLATION BY RAT-LIVER MITOCHONDRIA: NOTES ON THE INFLUENCE OF AGE, SEX, AND DIET. K. Surrey and S. A. Gordon.

Observations are summarized on the influence of age, sex, and diet on phosphorylative potential of rat-liver mitochondria. (C.H.)

1132 ANL-6200(p.27-8)
Argonne National Lab., Ill.
THE USE OF METHACRYLATE MEMBRANES TO PROTECT THIN SECTIONS FROM DAMAGE DURING ELECTRON MICROSCOPY. L. E. Roth.

A technique for the preparation of samples for electron microscopy which results in sharp membrane contours and requires less effort to focus for photography is described. (C.H.)

1133 ANL-6200(p.29-35)
Argonne National Lab., Ill.
THE ENVELOPE OF THE FAT CELL IN THE ELECTRON MICROSCOPE. F. Wassermann and T. F. McDonald.

Electron-microscope observations of the surface of the fat cell show that the cell wall which appears in light microscope sections of adipose tissue has a well-marked line or, seen from above as a distinct membrane, contains not only an outer layer of connective tissue and an inner layer of cytoplasm, both of varying thickness, but also the two lamellae described here together with the interlamellar space, as the envelope of the fat cell. The outer lamella is obviously continuous with the connective tissue ground substance and the inner lamella with the cytoplasm; thus the former is a surface layer of the limiting membrane of the ground substance and the latter is the surface structure of the cell or the true cell membrane. Although these membranes are different in kind, they are considered, together with the interlamellar space, as a functional unit which as a whole is instrumental in the transport of the material involved in the metabolism of the fat cell. (auth)

1134 ANL-6200(p.38)
Argonne National Lab., Ill.
A NOTE ON THE STATISTICAL DETERMINATION OF SHAPE OF CHROMATIN ELEMENTS IN CROSS SECTIONS OF NUCLEAR MATERIAL IN HUMAN SPERM. Bernard R. Nebel, Sylvanus A. Tyler, and Carol J. Murphy.

In the human sperm the chromatin particles were found to approximate a spherical shape when observed with the electron microscope. This was considered a result of the pathological condition involved. (auth)

1135 ANL-6200(p.39-43)
Argonne National Lab., Ill.
PRELIMINARY REPORT: TOPOLOGICAL BIOLOGY. Ernesto Trucco.

The concept of the organism as topological complex is discussed. Applications of gen l mathematical principles in biology are reviewed. (C ..)

1136 ANL-6200(p.44-5)
Argonne National Lab., Ill.
PROGRESS REPORT: DEUTERIUM OXIDE INTOXICATION IN RATS. II. ENZYMATIC DEHYDROGENATION OF TETRADEUTEROSUCCINATE. John F. Thomson, T. Richard Sato, John H. Pomeroy, and Carolyn A. Craig.

The rate of dehydrogenation of completely deuterated succinic acid was found to be only half as rapid as that of ordinary succinate when tested in the usual assay systems. In a test system made up with D_2O instead of H_2O, in which the only hydrogen atoms present were those in nonexchangeable positions of the enzyme and the acceptor, the rate of dehydrogenation was only one-fifth of the rate observed in the hydrogen system. Data are tabulated. (C.H.)

1137 ANL-6200(p.60-2)
Argonne National Lab., Ill.
THE LOCALIZATION OF BORONIC ACIDS IN MOUSE NEOPLASM. Norman A. Frigerio and Nicholas Bink.

Data are presented on the localization of boronic acids in mouse brain neoplasms following intravenous injection. (C.H.)

1138 ANL-6200(p.63-5)
Argonne National Lab., Ill.
TECHNIQUE OF WHOLE-BODY SHIELDING FOR THE NEUTRON-CAPTURE CHEMOTHERAPY OF TUMORS. Frances E. Knock, Norman A. Frigerio, and Howard H. Vogel, Jr.

A new technique is described for whole-body shielding during neutron-capture chemotherapy of tumors in mice. The method involves the incorporation of boron or lithium compounds into a soft mass of methyl methacrylate monomer and polymer, which can be made to polymerize at room temperature. A group of boxes of shielding compound is prepared in advance, and the tops of the boxes are then custom-polymerized to fit each individual tumor. (C.H.)

1139 ANL-6200(p.78-81)
Argonne National Lab., Ill.
THE RETENTION OF STRONTIUM-85 IN THE DOG. C. F. Decker and W. P. Norris.

The effect of age on the retention of Sr^{85} in dogs was studied. Data are presented graphically. (C.H.)

1140 ANL-6200(p.89-90)
Argonne National Lab., Ill.
PROGRESS REPORT: PLUTONIUM REMOVAL. III. EFFECT OF CHELATING AGENTS ON THE ULTRAFILTRATION OF INTRAVENOUSLY ADMINISTERED PLUTONIUM FROM PLASMA. Arthur Lindenbaum, William M. Westfall, and Jack Schubert.

The effects of two new polyaminoacid type chelating agents, diethylenetriaminepentaacetic acid (DTPA) and 2:2'-bis[di(carboxymethyl)amino] diethyl ether (BAETA), on the ultrafiltration of intravenously administered plutonium from plasma were measured. Results are compared with effects of ethylenediaminetetraacetic acid (EDTA). (C.H.)

1141 ANL-6200(p.91)
Argonne National Lab., Ill.
ANTIBODY AGAINST THE TISSUE MAST CELLS. Yevette S. Lewis and Douglas E. Smith.

Experiments are being carried out for the purpose of obtaining an antibody specifically against the tissue mast cells, which could be used to produce animals that are free of mast cells. Preliminary results are reported. (C.H.)

1142 ANL-6200(p.92-3)
Argonne National Lab., Ill.
AN IMPROVED METHOD FOR CONTRAST RADIOAUTOGRAPHY OF BONE. Phyllis E. Jenkins and William P. Norris.

An improved method is described for contrast radioautography of bone, following the uptake of radioisotopes. (C.H.)

1143 ANL-6200(p.94-7)
Argonne National Lab., Ill.
EXPERIMENTS ON THE BIOSYNTHESIS OF AZETIDINE-2-CARBOXYLIC ACID IN CONVALLARIA MAJALIS.
F. Schlenk and J. L. Dainko.

It appears that S-adenosylmethionine and S-methylmethionine do not play a major role in the formation of azetidine-2-carboxylic acid by Convallaria majalis. The failure to demonstrate this process in vitro does not strictly exclude its occurrence in vivo. (auth)

1144 NP-9054
Chicago. Univ. Air Force Radiation Lab.
QUARTERLY PROGRESS REPORT NO. 36. July 15, 1960. 115p. Contract AF41(657)-252.

The degree of modification of the radiation-induced increases in the adenosine triphosphatase activity of the spleen and thymus glands and decreases in the acetylcholinesterase activity of the small intestines of rats pretreated with various chemical combinations was used as a means of quantitatively determining the radioprotective effect of chemical agents. Data are included on the effects of serotonin, 5,5'dithiobis-(2-nitrobenzoic acid), and combinations of these agents. Progress is reported in a detailed study of the effects of β-aminoethylisothiuronium on the enzyme systems of mammalian tissues. This study is part of a program designed to extend the available information on the biochemical mechanisms responsible for the radioprotective actions of various sulfur-containing radioprotective agents. Progress is reported in studies on the toxicity of rare-earth oxides and nitrates, and the biological effects of simultaneous exposure to ionizing radiations and rare-earth elements. Fifty-four tissue extracts prepared from bovine thymus, red and yellow bone marrow and porcine spleen, intestinal mucosa, and pancreas were tested for radiotherapeutic activity by administering the material to mice for five days following a lethal exposure to whole-body x irradiation. None of the extracts tested exhibited marked therapeutic effects. Results are tabulated from screening tests on the radioprotective effects of 110 chemical compounds in x-irradiated mice. Seventeen of these compounds exhibited some protective effect. Data are included from pharmacological studies on the radioprotective activity of serotonin and aminoethylisothiuronium. (C.H.)

1145 NP-9162
Liège. Université. Institut de Therapeutique Experimentale.
ISOTOPE STUDIES ON BONE SALTS. Marcel J. Dallemagne and Leon Richelle. June 1960. 18p. (AF-SAM-Review 1-60).

Issued by School of Aviation Medicine.

A survey is made of twenty years of radioisotope studies of the molecular structure of bone and dental salts. The main purpose was to define bone and tooth salts. (54 references). (T.R.H.)

1146 NYO-7147
Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.
INVESTIGATION OF THE EPIZOOTIC AND POTENTIALLY EPIZOOTIC DISEASES OF MICE. Final Report [for] June 15, 1953–September 14, 1958. Edwin B. Murphy and Warren G. Hoag. Oct. 17, 1960. 18p. Contract AT(30-1)-1539. OTS.

Progress is reported on a study of the natural diseases of mice to establish standards of freedom from disease in order to provide healthier mice for research purposes. Significant findings and accomplishments in disease control and environmental control are summarized. (T.R.H.)

1147 NYO-9131
Columbia Univ., Palisades, N. Y. Lamont Geological Observatory.
STRONTIUM AND CALCIUM METABOLISM IN MAN. Final Report. Arthur R. Schulert. July 13, 1960. 36p. Contract AT(30-1)-2116. OTS.

Results of investigations of strontium and calcium metabolism in man are reported. Research aimed at determining the material balance of Sr^{90} in subjects under a variety of conditions of diet and therapy is described along with simultaneously conducted comparative studies of Sr^{85} (and in some cases Ca^{45}) metabolism. A study of the stable strontium disposition as a means of comparing the fate of equilibrated strontium with nonequilibrated Sr^{90} was also conducted. Long-term studies on Sr^{85} excretion and body load as an index for estimating the body load from an excretion rate are described, and results and conclusions are included. (J.R.D.)

1148 NYO-9512
Massachusetts. General Hospital. John Collins Warren Labs., Boston.
A STUDY OF THE MECHANISMS OF PROTEIN AND NUCLEIC ACID METABOLISM AND THEIR RELATIONSHIP TO RADIATION DAMAGE. Progress Report [for] June 1, 1959 to May 31, 1960. 13p. Contracts AT(30-1)-609 and AT(30-1)-1207. OTS.

Reports are given of five separate studies related to the general topic. Separate abstracts have been prepared for each. (T.R.H.)

1149 NYO-9512(p.4-5)
Massachusetts. General Hospital. John Collins Warren Labs., Boston.
STUDIES OF MECHANISMS OF PROTEIN AND NUCLEIC ACID SYNTHESIS.

A partial separation of valine-RNA from other soluble RNA molecules has been achieved by oxidizing non-amino-acid RNA to dialdehyde, forming a hydrazone, and coupling with tetrazotized o-dianisidine to form a blue dye bound to the RNA. This is then separated from amino-acid RNA by phosphate-propanol. Later steps in protein biosynthesis were investigated, and it was shown that soluble enzymes plus GTP and ATP are necessary for transfer of soluble RNA to ribosomes. (T.R.H.)

1150 NYO-9512(p.9-11)
Massachusetts. General Hospital. John Collins Warren Labs., Boston.
STUDIES IN TISSUE SPECIFICITY.

Investigations are reported on male histocompatibility antigens in mouse endocrine tissues and runt disease (graft-host reaction) in mice. (T.R.H.)

1151 ORO-311
Meharry Medical Coll., Nashville. Cancer Research Labs.
FINAL SCIENTIFIC REPORT [ON THERAPEUTIC USES OF RADIOACTIVE COLLOIDS]. P. F. Hahn. July 12, 1960. 41p. Contract AT(40-1)-269. OTS.

Results are summarized from a series of studies on experimental animals and human patients using radioactive colloids and other radioactive materials. About 560 patients with malignant disease were treated with radioactive gold or silver-coated radioactive gold colloids. In addition, therapeutic and tracer studies on various clinical conditions were carried out using P^{32}, I^{131}, Ag^{110}, Ag^{111}, Na^{24}, Cu^{64}, and Pd^{109}. A list is included of 76 publications relating to the studies. (C.H.)

1152 ORO-312

Emory Univ., Atlanta. School of Medicine.

TO INVESTIGATE AND EVALUATE RADIOISOTOPES FOR TELETHERAPY. Final Report for September 1, 1954–August 31, 1959. H. S. Weens. 70p. Contract AT(40-1)-1759. OTS.

The design and construction of a 1000 c rotating Co^{60} teletherapy unit are described. Clinical results in the treatment of advanced or recurrent neoplasms are summarized. Dosage measurements and the efficiency of various instruments for dosimetry are discussed. (C.H.)

1153 TID-4040

Division of Biology and Medicine, AEC.

MARINE SCIENCES RESEARCH. Jan. 1960. 42p. OTS.

Research supported by the Division of Biology and Medicine, USAEC, is described. After a general statement regarding AEC interests and information requirements in the field, the contractor, contract number, brief title, investigator, and scope of each contract is given. (T.R.H.)

1154 TID-6210

Massachusetts. General Hospital. Neurosurgical Service, Boston.

LOCALIZATION OF FOCAL INTRACRANIAL LESIONS BY SCANNING OF RAYS FROM POSITRON-EMITTING ISOTOPES. John Mealey, Jr., Saul Aronow, Gordon L. Brownell, and William H. Sweet. [1959?]. 51p. Contract AT(30-1)-1242. OTS.

Positron-emitting isotopes of arsenic and copper, injected intravenously, were used for the localization of brain tumors and other intracranial lesions. Scanning was accomplished by coincidence counting of the paired annihilation γ rays from the positron-emitting copper or arsenic. The biological reactions of inorganic arsenate and arsenite and of copper versenate in man are discussed. Radioassay of biopsies of the principal normal cephalic tissues, of various types of neoplasms, of hematomas, abscesses, and zones of demyelination was carried out. Concentrations of isotopes were increased in all tumors. Hematomas, abscesses, and large zones of demyelination also had concentrations high enough to permit localization in the majority of patients. The results of more than 3000 scans on 334 patients are summarized. A correct diagnosis was made in 80% of 249 tumors scanned with arsenic and in 70% of 84 tumors scanned with copper. 19 references. (C.H.)

1155 TID-6220

Massachusetts. General Hospital, Boston and Massachusetts. General Hospital. Physics Research Lab., Boston.

EXTERNAL LOCALIZATION OF BRAIN-TUMORS EMPLOYING POSITRON-EMITTING ISOTOPES. Progress Report [for] July 1, 1959–July 1, 1960. July 13, 1960. 33p. Contract AT(30-1)-1242. OTS.

Applications of positron-emitting isotopes and automatic scanning for the detection and localization of intracranial lesions are described. Problems of isotope production are reviewed. Emphasis is placed on the production of As^{72} with a half life of 26 hr. Results are reviewed on 385 scans performed over a 3.5-year period on a special group of 334 patients. Nearly all proved to have focal lesions established by gross anatomical and histological diagnosis after surgery and autopsy. In this group a correct diagnosis was made in 80% of 249 tumors scanned with As^{74} and 70% of 84 tumors scanned with Cu^{64}. During 1959, 616 patients were scanned with As^{74} and Cu^{64}. A study was made on applications of Ga^{68} in scanning. Design modifications are reported in a positron camera. Preliminary applications are illustrated. (C.H.)

1156 TID-6394

Indiana. Univ., Bloomington.

STUDIES ON HYDROGEN OXIDATION IN CELL-FREE EXTRACTS OF HYDROGENOMONAS EUTROPHA. Final Technical Report from September 1954 to August 1959. Charles L. Wittenberger and Roy Repaske. 30p. Contract AT(11-1)-251. OTS.

Progress is reported in investigations of energy transport in bacterial cell-free extracts. A list of publications is included. In addition, studies were made of hydrogen oxidation in cell-free extracts of autotrophically grown Hydrogenomonas eutropha. In crude extracts DPN, oxygen, and a variety of dyes can serve as electron acceptors during hydrogen oxidation. The reduction of DPN by hydrogen appears to require the mediation of one or more unidentified cofactors. Hydrogenase, as assayed either by methylene blue reduction or by DPN reduction, was recovered in the supernatant fluid after centrifugation for 1 hr at 144,000 gravities. These soluble hydrogenase preparations contain endogenous flavin and a single cytochrome of the c type, both of which are reduced by hydrogen and by DPNH. The extracts also catalyze an aerobic oxidation of DPNH via a cyanide-sensitive pathway. (auth)

1157 TID-6539

Chile. Universidad, Santiago and Chile. Universidad, Santiago. Instituto de Biología "Juan Noe."

INTEGRATION OF THE GENOTYPE IN GEOGRAPHIC POPULATIONS OF DROSOPHILA PAVANT. Danko Brncic. 1958. 13p. Contract AT(30-1)-2465. OTS.

Crosses were made between geographic races of D. pavani from localities of Chile and Argentina. All these populations were polymorphic for the gene arrangements in chromosomes II, IV-R, and IV-L, owing to the occurrence of inversions. After 10 generations, it was observed that the five parental populations which served as controls had maintained the frequencies of the heterozygotes for the inversions at about the same values as those found in nature. On the other hand, in the nine populations of mixed geographic origin, the frequencies of heterozygotes decreased very significantly. These results suggest that the higher fitness of the inversion heterozygotes depends on the internally balanced gene systems maintained in the inverted segments of the chromosomes. Through a process of natural selection, the systems have become different in each Mendelian population. In the interpopulational hybrids these coadapted gene systems are destroyed, owing to crossing over between chromosomes with the same gene orders. As a consequence, the heterozygotes for inversions no longer possess superior fitness. (auth)

1158 TID-6594

Inter-American Inst. of Agricultural Sciences. Turrialba, Costa Rica.

THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Quarterly Report. July 1, 1960. 47p. Contract AT(30-1)-2043. OTS.

Preliminary results are reported from studies on the effect of pH on the foliar absorption and translocation of P^{32} applied to the leaves of coffee plants; tracer studies on the extractable phosphates from fertilizers in tropical soils; the effects of radiation exposure on flushing of rubber trees and CACAO plants and the growth of palm trees; the radiosensitivity of grasses and cotton plants; the induction of mutants following the x-ray and neutron bombardment of coffee seeds; and the induction of rice mutants following γ irradiation of seeds. (C.H.)

1159 TID-6729(Paper 2)

Marquette Univ., Milwaukee. School of Medicine.

THE EFFECTS OF GLYCEROL, FREEZING AND STORAGE

AT LOW TEMPERATURES AND DRYING BY VACUUM SUBLIMATION ON OXIDATIVE PHOSPHORYLATION BY MITOCHONDRIAL SUSPENSIONS. D. Greiff, M. Myers, and C. A. Privitera. Paper 2 of RELATION OF RICKETTSIAL AND VIRAL INFECTIONS TO RADIATION INJURY. 30p.

The effects of glycerol on the cryotolerance of suspensions of mitochondria, using oxidative phosphorylation as the measure of biochemical integrity, were determined. Oxidative phosphorylation was not altered in suspensions prepared in isotonic sucrose containing 10% glycerol and frozen slowly at −76°. Storage at −65° for 15 days did not alter the capacities of these suspensions to esterify inorganic phosphate or take up oxygen. Other concentrations, 5 and 20%, were suboptimal or partially toxic, respectively. Phosphorylation by suspensions frozen at −76° and partially dried by vacuum sublimation at −40° declined more rapidly than did oxidation. Suspensions of mitochondria frozen slowly at −76° and dried completely by vacuum sublimation at several temperatures were inactive upon rehydration. The inactivation by complete drying was not altered by protective substances, "substrate premix," 5% gelatin, or 10% glycerol. (auth)

1160 TID-6729(Paper 3)
Marquette Univ., Milwaukee. School of Medicine.
THE LEVEL OF LACTIC DEHYDROGENASE ACTIVITY AS AN INDICATOR OF THE GROWTH OF INFLUENZA VIRUS IN THE EMBRYONATE EGG. Richard Kelly and Donald Greiff. Paper 3 of RELATION OF RICKETTSIAL AND VIRAL INFECTIONS TO RADIATION INJURY. 13p.

A qualitative test for the presence of infection by influenza virus was developed. The test is based on the great increase in lactic dehydrogenase activity in infected eggs. (T.R.H.)

1161 UCRL-9204
California. Univ., Berkeley. Lawrence Radiation Lab.
A TRAPEZOIDAL-WAVE ELECTROMAGNETIC BLOOD FLOWMETER. Howard M. Yanof and Paul Salz. June 4, 1960. 42p. Contract W-7405-eng-48. OTS.

The electromagnetic flowmeter is an instrument that measures the velocity of a fluid moving in a tube or pipe. By constraining the vessel in a sleeve, flow may be measured directly. A magnetic field crosses the tube at 90° to the axis of the tube and to the plane of the electrodes. As the ions in the fluid pass the magnetic field, a voltage is induced in the electrode. This flowmeter is different from existing flowmeters because of the unique trapezoidal waveform that energizes the magnet. It was found that there are serious difficulties with electromagnetic flowmeters using sine waves or square waves. The trapezoidal-wave electromagnetic blood flowmeter is described. This new flowmeter is compared with other types of electromagnetic flowmeters. The construction of the transducer element is also discussed. (auth)

1162 WADC-TR-59-126
Miami Valley Hospital, Dayton, Ohio.
I^{131}-LABELED DIIODO-P-AMINOHIPPURIC ACID AS A TRACER IN CARDIAC OUTPUT STUDIES. Period [covered] July 31, 1958 to July 31, 1959. George M. Homer, Robert E. Zipf, Thomas E. Hieber, Spencer F. August, and Bernard J. Katchman. Dec. 1959. 48p. Project No. 7164. Contract AF33(616)-3588. OTS.

Radioiodinated diiodo-p-aminohippuric acid ($DI^{131}PAH$) was synthesized as the sodium salt and examined for its potential usefulness in measuring the cardiac output in animals. This labeled compound was injected intravenously into rats, rabbits, and 11 dogs for study. Following the administration of $DI^{131}PAH$ to dogs, the rapid removal from the blood stream was calculated as 50 and 90% in 1.8 and 9.3 min, respectively. Forty per cent of the injected radioactivity was collected in the urine over an average experimental period of 3 hr. On autopsy of injected and sacrificed dogs, only a very low level of radioactivity was found to have localized in the tissues. Although the gall bladder was found to concentrate the injected compound or a metabolite thereof in the bile, this organ was readily emptied of its contents by means of olive-oil administration to the animal previous to and following the injection of $DI^{131}PAH$. Cardiac-output studies determined with $DI^{131}PAH$ on dogs were reproducible and in the range of reported values determined with other materials. The advantage of $DI^{131}PAH$ over other labeled materials for the measurement of cardiac output is discussed. (auth)

1163 AEC-tr-4089
Akademiya Meditsinskikh Nauk S.S.S.R.
NEUROHUMORAL REGULATION OF CELL DIVISION. (O Neĭrogumoral'noĭ Regulyatsii Kletochnogo Deleniya). V. M. Mastryukova and A. D. Strzhizhovskiĭ. Translated by Lydia Venters (Argonne National Lab.) from United Nations Report A/AC.82/G/L.329. 12p. JCL or LC.

Results are reviewed from a number of studies on factors regulating cell division. The formation of adrenaline during radiation exposure of animals and the role of adrenalin as an inhibitor of cell mitosis are discussed. 48 references. (C.H.)

1164 DEG-Inf. Ser.-102
ACCUMULATION OF THE RADIO-ISOTOPE OF CERIUM BY FRESH-WATER MOLLUSCS. G. G. Polikarpov. Translated by G. D. Taylor (U.K.A.E.A., Risley) from Priroda No. 5, 86-7(1958). 3p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 13694.

1165 JPRS-5649
MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, Volume VI, No. 6, 1960. 281p. OTS.

1166 JPRS-5649(p.1-23)
UTILIZATION OF NATURAL RADIOACTIVE ISOTOPES AT HEALTH-RESORTS AND UNDER OTHER CONDITIONS FOR THERAPEUTIC PURPOSES. E. S. Shchepot'eva (Ye. S. Shchepot'yeva) and S. N. Ardashnikov. Translated from Med. Radiol. 6, No. 6, 3-11(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22729.

1167 JPRS-5649(p.24-36)
DOSIMETRIC CONTROL IN WORKING WITH RADIOACTIVE ISOTOPES AND SOURCES OF RADIATION. A. N. Krongauz. Translated from Med. Radiol. 6, No. 6, 11-16 (1960).

The need for dosimetric control for workers with radioisotopes and radiation sources in the USSR is pointed out, and existing instrumentation and organization for dosimetric control are described. An adequate program should include personnel dosimetry and a periodic check of the external radiation level in work areas. With open sources additional care should be devoted to contamination levels, atmosphere levels, and disposal. Instrumentation needed to complete the existing types for adequate control is suggested. Standards for instruments and procedures are set up. (T.R.H.)

1168 JPRS-5649(p.37-45)
CLINICAL OBSERVATIONS IN THE TREATMENT OF THYROTOXICOSIS WITH RADIOACTIVE IODINE. L. G. Alenina. Translated from Med. Radiol. 6, No. 6, 17-20 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22777.

1169 JPRS-5649(p.63-70)
DETERMINATION OF THE ABSORPTIVE FUNCTION OF THE SMALL INTESTINE BY THE METHOD OF RADIOINDICATION. K. M. Prostyakov and E. (Ye.) A. Beyul. Translated from Med. Radiol. 6, No. 6, 27-9(1960).

Methods for determining the absorptive function of the small intestine are reviewed, and a method using I^{131} is described. The I^{131} is introduced through a duodenal tube, and the thyroid gland count taken after 3 or 4 min. The test was run on 48 patients including controls. Nine patients suffered from chronic colitis; ten patients suffered from chronic enteritis; and twenty were patients on which small intestine resection was done. There was a control group of seven persons. The test was found to be simple and reliable. In severe enteritis and resections of the small intestine, the absorption is delayed. (T.R.H.)

1170 JPRS-5649(p.71-81)
DETERMINATION OF THE RETENTION FACTOR OF SHORT-LIVED DAUGHTER PRODUCTS OF RADON IN THE HUMAN RESPIRATORY ORGANS. G. S. Berezyuk, V. V. Bulatov, L. D. Rogov, and I. L. Shalaev (Shalayev). Translated from Med. Radiol. 6, No. 6, 30-4(1960).

The lung retention factor of radon decay products is needed for calculation of the maximum permissible concentrations in air of industrial plants and absorbed dose in lungs. Experimental and calculated values differ considerably, so that an attempt was made to relate this value to the respiratory routine or pulmonary ventilation. Investigations were performed in a 5 m^3 chamber, the subjects being exposed to a total radon activity 10 times less than the maximum permissible dose. The results are tabulated and discussed. With increased dust content and heavy physical exertion, the MPC for short-lived radon daughters should be lower. The routine of respiration (ventilation of lungs and respiration depth and rate) to a considerable degree determines the maximum permissible norms for inhaled toxic substances. (T.R.H.)

1171 JPRS-5649(p.82-91)
THE EFFECT OF RADON WATER ON THE PERIODIC MOTOR ACTIVITY OF THE STOMACH. Yu. K. Vasilenko. Translated from Med. Radiol. 6, No. 6, 34-8(1960).

A study was made of the effect of 24-hr single and triple infusions of radon water on periodic gastric motor activity. Four dogs with gastric fistulas were used, and motor activity was studied by recording gastric motion by the balloon technique. Radon water of 1.5 μc/liter was introduced (200 cc at 20°C). The motor activity was stimulated because of a reduction in the rest phase and an increase in the activity phase. This increased activity persists for several days after administration of the water. The direct effect of triple doses is more marked than for single doses, but on subsequent days the effect is almost the same. (T.R.H.)

1172 JPRS-5649(p.102-11)
THE DISTRIBUTION OF CERIUM AND RUTHENIUM IN RAT ORGANS AFTER INHALATION. L. A. Buldakov, Yu. I. Moskalev, and D. N. Semenov. Translated from Med. Radiol. 6, No. 6, 42-7(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22742.

1173 JPRS-5649(p.122-32)
ABSORPTION OF A MIXTURE OF LONG-LIVED β-EMITTERS BY PLANKTON. A. F. Fedorov. Translated from Med. Radiol. 6, No. 6, 51-4(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22747.

1174 JPRS-5649(p.158-63)
ACETONE BODIES IN THE BLOOD FROM THE EFFECT OF IONIZING RADIATION IN PATIENTS WITH MALIGNANT TUMORS. V. P. Dzhanpoladova and M. L. Kulikova. Translated from Med. Radiol. 6, No. 6, 66-7(1960).

The content of acetone bodies in the blood was studied in 30 gynecological patients before and after irradiation as an index of changes in intermediate metabolism. The data obtained lead to the conclusion that acetone body levels in patients with malignant tumors is increased in almost all cases. After irradiation a further increase is noted in ketonemia, whereas in individual cases a marked ketosis develops, apparently from a disturbance in the oxidative processes and accumulation of insufficiently oxidized products in the blood. (T.R.H.)

1175 JPRS-5649(p.164-6)
CHANGES IN THE CARDIOVASCULAR SYSTEM IN RADIATION THERAPY. V. M. Lashchevker. Translated from Med. Radiol. 6, No. 6, 67(1960).

An observation was made of the condition of the cardiovascular system in 46 patients given radiotherapy. Fourteen received P^{32} for polycythemia, eight received I^{131} for thyrotoxicosis, eight received teleroentgen therapy for brucellosis, and sixteen received deep x-ray therapy for neoplasms of the mammary gland and uterus. No direct relation of myocardium condition to radiation treatment was found. (T.R.H.)

1176 JPRS-5649(p.188-246)
SEROTONIN. G. A. Chernov. Translated from Med. Radiol. 6, No. 6, 75-87(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22730.

1177
RETENTION AND FATE OF IRIDIUM-192 IN RATS FOLLOWING INHALATION. L. J. Casarett, S. Bless, R. Katz, and J. K. Scott (Univ. of Rochester, N. Y.). Am. Ind. Hyg. Assoc. J. 21, 414-18(1960) Oct.

The pharmacodynamics of metallic Ir^{192} was studied in rats after inhalation. Data are presented graphically. (C.H.)

1178
NUCLEIC ACID CONTENT AND RADIOSENSITIVITY OF ESCHERICHIA COLI. E. (Ye.) V. Moiseyenko (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation) 5, No. 2, 203-7(1960).

Determination of the DNA and RNA content in two cultures of E. coli, normal and glucose, differing in radiosensitivity and the shape of the dose-survival curve, showed that the DNA content per cell was 2.7 times and the RNA content 4.8 times greater in the glucose than in the normal culture, which may serve as the basis for assuming the cells of the glucose culture to be of a polyploid character. The cells of the glucose culture were 5 times greater in volume than the cells of a normal culture and 3.5 times greater in dry weight. The cultures did not differ in their water content. (auth)

1179
DATA ON THE RADIOSENSITIVITY OF AGRICULTURAL CROPS. S. A. Valeva. Biophysics (U.S.S.R.) (English Translation) 5, No. 2, 284-9(1960).

Data are tabulated on the radiosensitivity of a number of agricultural crops. The data were compiled to facilitate the choice of radiation doses for plant selection studies. (C.H.)

1180
FURTHER STUDIES RELATING TO THE IMPLICATIONS OF RADIATION SURVIVAL CURVE DATA FOR TREAT-

MENT OF CBA MOUSE LEUKAEMIA BY WHOLE-BODY IRRADIATION. H. B. Hewitt and C. W. Wilson (Westminster School of Medicine, London). Brit. J. Cancer 14, 186-94(1960) June.

A survival curve for CBA mouse leukemia cells irradiated in vivo in mice of the substrain of origin was described previously. Further experiments are described, which were undertaken with the object of examining various factors that could effect proper interpretation of that survival cure. A bioassay method was employed to show that a heavy preponderance of admixed radiation-killed leukemia cells did not influence the ability of small inocula of viable cells to give rise to leukemia after transplantation and that preliminary whole-body irradiation did not influence the resistance of host mice to subsequent small inocula of viable leukemia cells. Groups of mice bearing known numbers of viable leukemia cells were exposed to 1600 r whole-body radiation and treated with intravenous isologous bone marrow. The proportion of mice in each group, which were thereby cured of leukemia, was strictly in accordance with prediction from the original survival curve data. This last experiment is deemed to exemplify a generally applicable thesis for the radiotherapy of malignant tumors in autologous or truly isologous systems: that the curative dose of radiation for malignant cell populations of known size irradiated in vivo can be prescribed from relevant survival curve data. The further problems likely to be encountered in such applications of survival curve data are discussed. (auth)

1181

A METHOD OF ASSAYING CALCIUM 47. Elizabeth Jones (Hammersmith Hospital, London). Brit. J. Radiol. 33, 721(1960) Nov.

A method is described for the radiometric determination of Ca^{47} in samples of urine and blood. (C.H.)

1182

PRACTICAL APPLICATION OF RADIOACTIVE METALS. Lee E. Farr, Victor P. Bond, George C. Cotzias, Daniel Laszlo, and Stuart W. Lippincott (Brookhaven National Lab., Upton, N. Y.). Bull. N. Y. Acad. Med. (2) 36, 510-37 (1960) Aug.

The transcript of a panel discussion on the practical applications of radioactive metals in medicine is given. The effects of radioisotopes on tissues; their therapeutic usefulness; some specific approaches used in isotope therapy; the properties that make isotopes desirable or undesirable; the control and care of malignant diseases through the use of radioisotopes; and the development of methods leading to more precise localization of radioisotopes for therapeutic purposes and resulting in a better understanding of the effects of radioisotopes should they contaminate body structures were discussed. (M.C.G.)

1183

CHEMICAL APPROACHES TO RADIATION PROTECTION IN MAMMALS. Harvey M. Patt (Argonne National Lab., Ill.). Federation Proc. 19, 549-53(1960) July.

A review is presented of developments in chemical protection against radiation. (37 references) (T.R.H.)

1184

GENETIC ASPECTS OF IMPLANTATION OF BLOOD-FORMING TISSUE. Elizabeth S. Russell (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Federation Proc. 19, 573-8(1960) July.

A selective review of published literature since 1953 on genetics of hematopoietic transplants is presented. Discussion centers about two developments with animals of known genotype. One is provision of genetically determined characteristics, differing between host and donor, which may be used to test in plantation and persistence of injected tissue and analyze host-graft interactions. The other is demonstration that the specific genetic nature (of host and implanted tissue) and genetic relation between donor and host are important factors. (49 references) (T.R.H.)

1185

DIRECT LIQUID SCINTILLATION COUNTING OF PLASMA AND TISSUES. Egil Gjone, Hugh G. Vance, and David Alan Turner (Sinai Hospital of Baltimore, Inc., Md.). Intern J. Appl. Radiation and Isotopes 8, 95-7(1960) July. (In English)

A new simplified and quantitatively reproducible method for the liquid scintillation counting of C^{14} and H^3 in small volumes of plasma is described. Equal volumes of plasma and 5N KOH are mixed and heated; 0.2 ml of this mixture is dissolved in 18 ml of a 30% (v/v) methanol in toluene counting solution. (auth)

1186

SUITABILITY OF VARIOUS PLATING MEDIA FOR COUNTING BACTERIA AFTER EXPOSURE TO GAMMA RADIATION. Barbara M. Freeman and B. A. Bridges (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Intern. J. Appl. Radiation and Isotopes 8, 136-8(1960) July. (In English)

The suitability of various plating media for growth of bacteria after irradiation was investigated for six organisms. Data are tabulated on mean values of the surviving fraction of each organism on each of the plating media tested. E. coli B/r was the only organism of the six where the extent of the post-irradiation effect is dependent upon the medium on which the cells were grown. (C.H.)

1187

A TOTAL BODY IRRADIATION CHAMBER AND ITS USES. Melville L. Jacobs and Leon Pape (City of Hope National Medical Center, Duarte, Calif.). Intern. J. Appl. Radiation and Isotopes 8, 141-2(1960) July. (In English)

A total-body gamma irradiation chamber is described for studies on small laboratory animals. The chamber uses four 300c Cs^{137} sources. Diagrammatic sketches are included. (C.H.)

1188

URINE RADIOGRAPHY OF EXCRETED IODIDE. A NEW RENAL FUNCTION TEST. Burton P. Grant and Russell Wigh (Medical Coll. of Georgia, Augusta). J. Am. Med. Assoc. 174, 1304-7(1960) Nov.

A new technique, excretory urine radiography, for estimating organic iodide excretion after its intravenous injection is simple and inexpensive. Its accuracy was proved by comparison with chemical and isotopic measurements of iodide excretion. It facilitates measurement of glomerular filtration. It adds to excretory urography an important needed feature or may be employed as a separate renal function test. The range of normal values is provisionally considered as those above 20% excretion of diatrizoate in 30 min. (auth)

1189

NITROGEN BALANCE IN HUMANS BY EXCHANGE OF NON-ALBUMIN NITROGEN (USING N^{15}). E. v. Shramlik (Universität, Berlin), A. Kohlstrunk, and I. Schütt. Kernenergie 3, 847-52(1960) Sept. (In German)

The possibility of an improvement of the nitrogen balance was investigated by giving a diet poor in albumin with the addition of an organic or inorganic ammonium salt, respectively (diammonium adipinate or ammonium chloride). The course of ammonium was traced using nitrogen labeled

by N^{15}. A great part of the labeled nitrogen was excreted with the urine, a small part was incorporated into the serum albumin and remained about 4 to 5 weeks in the blood. Therefore part of the labeled nitrogen of nonalbumin diet was turned to the albumin of human body. (auth)

1190

EVALUATION OF A CLINICAL TREATMENT METHOD USING THE STABLE ISOTOPE O^{18}. V. Görisch (Institut für Pharmakologie und Toxikologie, Leipzig), R. Ludewig, and G. Hübner. Kernenergie 3, 853-4(1960) Sept. (In German)

For the clinical treatment of disturbances in blood flow insufflation of oxygen is applied. Using oxygen labeled with O^{18} it is shown that a great part of the insufflated oxygen is exhaled. Since the concentration of oxygen in the blood decreases, the effect of insufflation of oxygen cannot be explained by the assumption that the supply of oxygen to the tissue is improved. (auth)

1191

ISOTOPE EFFECTS IN BIOLOGICAL REACTIONS. I. Oehme (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 854-8(1960) Sept. (In German)

As a consequence of the different masses of isotopes of the same element, different reaction rates of the various isotopic compounds take place during biological processes. Therefore displacements of the isotopic ratio in the organism are possible. Such processes are important for analysis of experimental results and biological fractionation of isotopes. Various examples are cited. (auth)

1192

THE USE OF NITROGEN N^{15} IN STUDY OF THE PRODUCTS OF PHOTOSYNTHESIS. T. F. Andreeva (Inst. for Plant Physiology, Academy of Sciences, USSR). Kernenergie 3, 859-62(1960) Sept. (In German)

The synthesis of amino acids and proteins from inorganic nitrogen during photosynthesis is studied using nitrogen labeled with N^{15}. It is shown that the acceleration of forming amino acids and proteins by irradiation is caused by the fact that these compounds are directly formed during photosynthesis. In leaves free from chlorophyll, however, irradiation only accelerates the entrance of inorganic nitrogen into the plant. The influence of irradiation on the velocity of forming proteins depends on the physiological state of the plant. (auth)

1193

STUDIES ON PROTEIN FORMATION IN BARLEY SEED USING N^{15}. G. Michael (Friedrich-Schiller-Universität, Jena, Ger.). Kernenergie 3, 862-6(1960) Sept. (In German)

Immediately before blooming, barley was fertilized by nitrogen using N^{15} for labeling. The course taken by this labeled nitrogen in the plant is traced. It is shown that the labeled nitrogen passes the stalks rapidly and soon reaches the grains. Leaves take only a little part in this process. Within the ripening grain the labeled nitrogen is mainly enriched in the "endosperm," especially as prolamine and gluteline. Fertilizing by great amounts of nitrogen especially causes an enrichment of these proteins containing only little lysine. Thus we can understand the lower "biological value" of grains rich in proteins sometimes observed. (auth)

1194

THE EMPLOYMENT OF RADIOGOLD IN THE TREATMENT OF SOME MALIGNANT NEOPLASMS. A. V. Kantin, A. I. Strashinin, and K. N. Chochia (Central Scientific Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol. 5, No. 8, 9-12(1960) Aug. (In Russian)

A brief history on the use of radiogold in the treatment of malignant neoplastic diseases is given. The most effective modes of treating new growths are discussed. (auth)

1195

STUDIES OF THE THYROID FUNCTION WITH THE AID OF RADIOIODINE DURING RADIUM THERAPY OF CANCER OF THE LARYNX. K. N. Chochia and E. M. Shvartsberg (Central Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol. 5, No. 8, 14-18(1960) Aug. (In Russian)

The use of telegammatherapy (8000 to 9000 r) in patients suffering from cancer of the larynx produced a decrease of indices of radioiodine absorption. High and normal radioiodine absorption by the thyroid gland following radium therapy testified to the absence of lesions in the thyroid tissue and its high resistance to the action of curative doses of ionizing radiation. (auth)

1196

TYPICAL DESIGNS OF BUILDINGS FOR THE ORGANIZATION OF RADIOLOGICAL DEPARTMENTS FOR DIVERSE PURPOSES. S. L. Kanevskiĭ. Med. Radiol. 5, No. 8, 46-52(1960) Aug. (In Russian)

The characteristics of typical designs for radiological departments with presentation of design solutions, equipment, and technico-economical indexes are discussed. (auth)

1197

UTILIZING SURVIVAL TIME IN PROBIT ANALYSIS. Willie W. Smith and Jerome Cornfield (National Cancer Inst., Bethesda, Md. and Johns Hopkins Univ., Baltimore). Radiation Research 13, 540-6(1960) Oct.

In experiments involving relatively long survival after a challenge with homologous ascites tumor cells or midlethal irradiation, the utilization of information was increased by the transformation of survival times to scores and by subjecting the average scores to probit analysis as if they were survival percentages. A procedure for estimating the improvement in precision is described. (auth)

1198

BIOENERGETICS. Considerations of Processes of Absorption, Stabilization, Transfer, and Utilization. Proceedings of a Symposium Held at Brookhaven National Laboratory, October 12-16, 1959. Leroy G. Augenstine, ed. Radiation Research, Suppl. 2, 690p. (1960).

Separate abstracts have been prepared on 21 papers presented at the Bioenergetics Symposium held at Brookhaven National Lab., Oct. 12 to 16, 1959. (C.H.)

1199

CONTROL OF GROWTH AND REPRODUCTIVE PROCESSES BY RED AND FAR-RED LIGHT. James L. Liverman (U. S. Atomic Energy Commission, Washington, D. C.). Radiation Research, Suppl. 2, 133-56(1960).

The primary actions of low-intensity light in triggering the photoperiodic and photomorphogenic reactions in plants are discussed. Topics discussed include the photoperiodic control of flowering; low-intensity light reactions; the control of lettuce seed germination by light; the control of hypocotyl hook unbending with light; control of leaf expansion by light; control of anthocyanin synthesis by light; the control of oat coleoptile and mesocotyl growth by light; the action spectra for red and far red control of growth responses; the blue portion of the action spectra; reactions in the red and far red reaction system; and proposed areas of research. 59 references. (C.H.)

1200

STUDIES ON THE PHOTOCHEMISTRY OF RHODOPSIN AND CHLOROPHYLL. Henry Linschitz (Brandeis Univ.,

Waltham, Mass.). Radiation Research, Suppl. 2, 182-95 (1960).

The two most important problems in photobiology, photosynthesis and vision, are epitomized respectively by the two pigments, chlorophyll and rhodopsin. Contrary to early hopes, it now appears that these two pigments function by entirely different mechanisms. Nevertheless, certain techniques, such as flash photolysis and low-temperature irradiation, are well adapted for studying the light-induced reactions in both cases. Results are presented of such experiments, particularly using flash methods. Various aspects of the storage and utilization of light energy in biological systems, as exemplified in rhodopsin and chlorophyll are reviewed. 32 references. (auth)

1201

ENERGY TRANSFER IN PROTEINS AND POLYPEPTIDES. Lubert Stryer (Argonne National Lab., Ill.). Radiation Research, Suppl. 2, 432-51(1960).

Certain aspects of energy transfer in proteins are discussed. It is postulated that energy-transfer studies may prove useful in the elucidation of the conformation and microenvironment of proteins. Topics discussed include electronic-energy levels of proteins; energy transfer in amino acids and proteins with no prosthetic groups; energy transfer in proteins with prosthetic groups; mechanisms of conductivity of proteins; low-energy pathways; mechanisms of energy transfer in proteins; energy transfer in the study of macromolecular structure; and experimental approaches to the problem. 85 references. (C.H.)

1202

ENERGY UTILIZATION THROUGH COUPLED SYSTEMS. James A. Bassham (Univ. of California, Berkeley). Radiation Research, Suppl. 2, 497-502(1960).

Reactions in living systems which result in free-energy changes are discussed. Energy utilization through coupled systems is considered. Reactions resulting from the oxidation of glyceraldehyde phosphate to 3-phosphoglyceric acid are reviewed. It is stated that actual free-energy changes are different from the standard free-energy changes. Steps in carbon reduction during photosynthesis are considered. This reaction follows the same course as oxidation, but in reverse. A simplified version is presented of the carbon-reduction cycle, and reactions involved are discussed. (C.H.)

1203

COLLECTION AND UTILIZATION OF ENERGY IN PHOTOSYNTHESIS. Rufus Lumry and John D. Spikes (Univ. of Minnesota, Minneapolis and U. S. Atomic Energy Commission, Washington, D. C.). Radiation Research, Suppl. 2, 539-77(1960).

Types of photochemical reactions carried out by photosynthetic systems are reviewed. Topics discussed include evolutionary aspects of photosynthesis, photosynthetic apparatus, trapping of light quanta, studies of the fluorescence yield, the role of chlorophyll and chloroplasts, and the kinetics of photosynthesis and the Hill reaction. 86 references. (C.H.)

1204

TREATMENT OF MALIGNANT MELANOMA METASTASES WITH LIQUID RADIOISOTOPES. L. L. Likhovetskaya (State Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). Vestnik Rentgenol. i Radiol. 35, No. 4, 44-8(1960) July-Aug. (In Russian)

Fifty patients with melanoma metastases in the skin (48 cases), subcutaneous cellular tissue, muscles, and lymph nodes were treated. The number of metastases varied from 1 to 30. Au^{198} and $CrP^{32}O_4$ therapy (administration into the tumor) was conducted either alone or in combination with telegammatherapy. The most effective doses in Au^{198} and $CrP^{32}O_4$ treatment were from 50,000 to 150,000 rad. Direct satisfactory effects were obtained in all of the patients. Metastasis was not accelerated. There were remissions noted in 6 patients, in whom it was technically impossible to create a homogeneous irradiation field. As a rule, during this treatment the general condition of the patients remained unaffected. Fourteen patients were observed for a period of over 2 years, and 33 were observed from 1 to 2 years. (auth)

1205

THE BASIC PHYSICS OF RADIATION THERAPY. Joseph Selman. Springfield, Ill., Charles C. Thomas, 1960. 687p. $14.50.

The fundamental physical principles underlying radiation therapy are explained. The field of radiobiology is also surveyed. The material is presented from the standpoint of the radiologist or advanced student. A bibliography of 86 references is included, as well as a subject index. (C.H.)

1206

RADIATION THERAPY OF EARLY PROSTATIC CANCER. R. H. Flocks and D. A. Culp. Publication Number 399, American Lecture Series. A Monograph in American Lectures in Urology. Springfield, Ill., Charles C. Thomas, 1960. 78p. $4.50.

Radiotherapy of prostatic carcinoma is described and discussed. After a review of the developments leading to the present techniques, sections are devoted to handling of radioactive material, techniques of injection, and results. (T.R.H.)

Biochemistry, Nutrition, and Toxicology

1207 ANL-6200(p.19-26)

Argonne National Lab., Ill.

THE ROLE OF TRANSCARBOXYLATION IN PROPIONIC ACID SYNTHESIS. Robert W. Swick and Harland G. Wood.

Results are reported from studies with cell-free extracts of P. shermanii which have demonstrated that the conversion of pyruvate to propionate can occur without the formation of free CO_2 and that methylmalonyl CoA is an intermediate in the conversion. The results are summarized by equations. (C.H.)

1208 UCRL-9361

California. Univ., Berkeley. Lawrence Radiation Lab.

CURRENT STATUS OF CURIUM INHALATION EXPOSURES IN HUMANS. Howard G. Parker, Myron D. Thaxter, and Max W. Biggs. Sept. 1960. 12p. Contract W-7405-eng-48. OTS.

An incident is described concerning a curium accelerator target aerosolized by explosion. Management of the spill, sampling, particle sizing, and medical findings are presented. Seven of the 27 persons present showed low levels of curium excretion. Data from this incident were compared with those from three other inhalation exposures to curium compounds. (auth)

1209 CEA-tr-R-889

CONTRIBUTION À LA CONNAISSANCE DE LA TOXICOLOGIE DU RUTHÉNIUM RADIOACTIF ADMINISTRÉ PAR LA VOIE DIGESTIVE. (Contribution to the Knowledge of the Toxicology of Radioruthenium Administered by the Digestive Method). V. N. Streltzova and L. A. Buldakov. Translated into French by C. E. A. Marcoule from Med. Radiol. 3, No. 5, 37-49(1958). 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 2673.

1210 JPRS-5649(p.172-87)

THE TOXIC EFFECT OF RADIOACTIVE IODINE AFTER A SINGLE PER OS ADMINISTRATION. O. N. Gorbunov, V. G. Ryadov, and Yu. A. Klassovskiĭ (Klassovskiy). Translated from Med. Radiol. 6, No. 6, 69-74(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22743.

1211

ACUTE AND SUB-ACUTE TOXICITY STUDIES OF THALLIUM COMPOUNDS. William L. Downs, James K. Scott, Luville T. Steadman, and Elliott A. Maynard (Univ. of Rochester, N. Y.). Am. Ind. Hyg. Assoc. J. 21, 399-406 (1960) Oct.

Thallous acetate and thallic oxide showed marked toxicity when administered in single doses to rats, rabbits, guinea pigs, and dogs by various routes. Data are tabulated. (C.H.)

1212

RADIOCHEMICAL DEGRADATION OF CYSTAMINE AND DERIVATIVES. Doriano Cavallini, Bruno Mondovì, Beppino Giovanella, and Carlo de Marco (Università, Modena, Italy and Università, Rome). Ricerca sci. 30, 1178-85(1960) Aug. (In Italian)

Solutions of cystamine, cysteamine, cystamine disulfoxide, hypotaurine, cysteaminesulfonate, thiotaurine, and taurine, were irradiated with increasing doses of x rays. The extent of the degradation of the above compounds was followed by paper chromatography. The oxidation of cysteamine to cystamine was determined by titration of the thiol groups of the irradiated solution. It was observed that the compounds are degraded to a various extent and it was impossible to correlate the extent of degradation with the protecting power of the same compounds as found in the literature. The results are consistent with the opinion of a secondary role of the plain scavenging effect in the radioprotection by cystamine. The oxidation of cysteamine to cystamine on the contrary proceeds to such an extent to be of value in the protection as a scavenger. Nevertheless this reaction may have a radiobiological importance only if a selective absorption and accumulation of cysteamine in the body compared with other thiols is taken into consideration. (auth)

Fallout and Ecology

1213 A/AC.82/G/L.373

Brussels. Centre d'Etude de l'Énergie Nucléaire. PROGRAMME "EVOLUTION DU Sr^{90} DANS LES SOLS ET LES VEGETAUX." (RÉSULTATS D'ANALYSE DES ÉCHANTILLONS RECOLTES EN 1959). (Evolution of Sr^{90} in Soils and Plants. (Results of Analysis of Samples Collected in 1959)). R. Kirchmann, E. Vander Stricht, and M. De Visscher. Mar. 22, 1960. 20p.

Results of analyses of soils, rain, aerosols, vegetables, and milk collected in 1959 at the Sunshine Stations are given. Brief descriptions of the analytical methods are included. No interpretation of the data is made. (T.R.H.)

1214

THE INFLUENCE OF RADIOSODIUM ON THE EXCRETION OF RADIOACTIVE STRONTIUM FROM THE ORGANISM. Zh. Dooronbekov, Yu. N. Kasatkin, and N. A. Fedorov. Med. Radiol. 5, No. 8, 76-9(1960) Aug. (In Russian)

In experiments staged on rats it was demonstrated that radiosodium does not influence the excretion of radioactive strontium and is not conducive to its accumulation in the skeleton. (auth)

1215

RADIOACTIVE TRACING OF THE MOVEMENT OF AN ESSENTIAL ELEMENT THROUGH AN AQUATIC COMMUNITY WITH SPECIFIC REFERENCE TO RADIOPHOSPHORUS. R. F. Foster (General Electric Co., Richland, Wash.). Publ. staz. zool. Napoli 31, Suppl. 34-69(1959). (In English)

Radioisotopes may be used to trace the metabolism of substances through entire ecosystems and thus provide information available by no other means. The Columbia River below the Hanford reactors provides an unusual opportunity for the study of the uptake of radioisotopes by aquatic organisms since the organisms are chronically exposed to a fresh supply of isotopes introduced more or less continuously with the reactor effluent. The specific activity of the P^{32} in Columbia River water thus remains approximately constant throughout much of the year. The specific activity of Columbia River organisms is less than that of the water since radioactive decay of the P^{32} occurs in each trophic level. The decrease in specific activity is in direct proportion to the turnover time for the particular organisms and their position along the food chain. Since most aquatic animals are poikilothermic, their metabolic rates, and thus their turnover rates for phosphorus, change with variations in temperature and so with the season. At low temperatures the turnover time is relatively long, the specific activity is correspondingly low, and the concentration of the isotope in the animal is proportionately low. The reverse is true when temperatures are high. Once the rate constants for biological turnover of appropriate isotopes are established, the observed concentrations of isotopes in animals may be used to estimate feeding rates. Fish that inhabit the Columbia River downstream from the reactors accumulate some of the radioactive materials introduced with the reactor effluent. Although the amounts of isotopes picked up by the fish are too small to cause any detectable radiation damage or to constitute a hazard to persons who eat them, the deposited nuclides can easily be measured. Many of the whitefish (Prosopium sp.) that are taken as samples upriver from the reactors, contain P^{32}. The presence of this artificial isotope indicates an upstream migration of this species during the spring and late fall. 45 references. (auth)

1216

PHOSPHORUS AND BICARBONATE EFFECTS ON Sr^{85} ACCUMULATION BY BUSH BEANS. Arthur Wallace (Univ. of California, Los Angeles). Soil Sci. Soc. Am. Proc. 24, 327-8(1960) July-Aug.

Several exploratory studies were made of possible phosphorus and bicarbonate effects on the accumulation of Sr^{85} by bush beans. Without added bicarbonate, increasing the phosphorus increased the content of Sr^{85} in roots but had little effect on that in the tops. With a 10^{-2}M bicarbonate level, increasing the phosphorus resulted in a progressive decrease of Sr^{85} in both roots and tops. In the absence of phosphorus from the nutrient solution, the content of Sr^{85} in the roots increased markedly with the concentration of bicarbonate. (M.C.G.)

Radiation Effects on Living Tissues

1217 A/AC.82/G/R.175/Add.4

Sweden. Institutionen for Medicinsk Genetik, Uppsala. SOME RESULTS AND PREVIEWS OF RESEARCH IN SWEDEN RELEVANT TO HUMAN RADIATION GENETICS. Jan A. Böök Mar. 12, 1958. 10p.

Research concerning the frequencies of mutations and deleterious genes was studied for application to human radiation genetics. Several methods of studying human genetics were outlined including large-scale international investigations of the progeny of females who were subjected to x-ray photography due to congenital dislocation of the hip; experimental investigation of the effects of radiation on human cell cultures; and investigation of genetic disease entities, diagnostics of carrier states, and biochemical gene actions. (M.C.G.)

1218 A/AC.82/R.104
United Nations. Secretariat.
BACKGROUND NOTES FOR THE DISCUSSION OF GENETIC PROBLEMS BY THE COMMITTEE AT ITS EIGHTH SESSION. July 7, 1960. 38p.

A background paper is presented on genetic consequences of irradiation of man. The topics dealt with are: magnitude and control of natural mutation rates for man and other species, kinetics and mechanism of induced gene mutation, fate of natural or induced mutations, comparability of radiation-induced and spontaneous gene mutations, induced chromosome changes, continuously varying traits under polyfactorial control, possible genetic basis of somatic effects of radiation: chromosomal changes and carcinogenesis. (T.R.H.)

1219 AD-237044
Chicago. Univ.
THE RELATIONSHIP OF BIOCHEMICAL AND ENZYMIC ABNORMALITIES OF CELLS TO RADIATION SUSCEPTIBILITY AND TO THEIR INJURY BY OTHER AGENTS. Period covered: July 1, 1959–March 31, 1960. Alf S. Alving. 12p. Contract DA-49-007-MD-968.

Investigation of the relation of biochemical abnormalities in cells to their injury by various means were continued, using primaquine-type hemolysis as the model entity. Studies of the inactivation of G-6-PD by erythrocyte stromata have shown it is caused by pyridine nucleotidase activity of the stromata with consequent removal of oxidized triphosphopyridine nucleotide (TPN) found necessary to stabilize the G-6-PD in erythrocytes. Both TPN and DPN protect the G-6-PD of erythrocytes directly. Nicotinamide protects indirectly by interfering with the pyridine nucleotidase activity of the stromata. Intact cells also exhibit this activity, and the mechanism may be important in vivo. The TPN was shown to be bound to G-6-PD and rose and fell concomitantly with the activity of this enzyme. Another investigation was directed toward the development of a technique for in vitro hemolysis. Primaquine or Furadantin, when added to blood and exposed to ultraviolet light between wavelengths of 300 to 400 millimicra, are converted to hemolytic degradation products. The technique is still in a preliminary state, but it can be shown that the sequence of events leading to hemolysis includes the oxidation of the reduced glutathione, then a subsequent disappearance of the oxidized glutathione and the simultaneous formation of methemoglobin. These changes are found in both primaquine-sensitive and normal cells that have been washed and resuspended in saline; in whole blood these changes are found only in primaquine-sensitive cells. Some protection against this effect is given by ethylenediaminetetraacetic acid (EDTA). The system offers great promise because many phenomena associated with primaquine-sensitive hemolysis can be observed which cannot be shown in vivo because the cells are lysed and cannot be recovered in drawn blood. This technique reveals that sheep cells, primaquine-sensitive by test, behave like normal human cells and suggests that failure of sheep to undergo in vivo hemolysis when given primaquine parenterally is a factor of the sheep erythrocyte itself and not of a different metabolism of primaquine. The technique of gel filtration has also been developed in this laboratory for separating free and bound forms of glutathione and coenzymes as well as the degradation products of primaquine. (auth)

1220 AF-SAM-60-66
School of Aviation Medicine, Brooks AFB, Tex.
BIOLOGIC EFFECTS OF NUCLEAR RADIATION IN PRIMATES. Robert W. Zellmer and John E. Pickering. Apr. 8, 1960. 12p.

Macaca mulatta primates were exposed to the neutron and γ radiation of nuclear detonations as one phase of an extensive animal program designed to yield a better understanding of the biologic effects of ionizing radiation. A field test utilizing ionizing radiation from nuclear devices was chosen to simulate as closely as possible the conditions of dose, dose rate, and radiation distribution that have occurred in human exposures. In both detonations the radiation dose required to produce death in 30 days for 50% of the animals was determined. All animals were followed for acute radiation effects; and in cases in which no mortality occurred, they are being followed for long-term effects such as cataract production, bone-marrow change, shortening of life span, and carcinogenesis. (auth)

1221 ANL-6200(p.5-7)
Argonne National Lab., Ill.
HEMOLYSIN PRODUCTION IN IRRADIATED RABBITS. VIII. COLCHICINE ACTIVITY. W. H. Taliaferro and B. N. Jaroslow.

Progress is reported in studies on the antibody-forming capacity of irradiated rabbits. The effects of yeast extract and colchicine on hemolysin values were compared. (C.H.)

1222 ANL-6200(p.36-7)
Argonne National Lab., Ill.
PROGRESS REPORT: STUDIES OF REGENERATING MAMMALIAN LIVER. I. CHANGES IN NUCLEIC ACIDS FOLLOWING PARTIAL HEPATECTOMY IN ANIMALS PREVIOUSLY SUBJECTED TO REPEATED X-IRRADIATION. A. D. Barton and Anna Kane Laird.

Data are tabulated on changes in nucleic acids during liver regeneration following partial hepatectomy in animals previously subjected to repeated x irradiation. (C.H.)

1223 ANL-6200(p.46)
Argonne National Lab., Ill.
RADIATION-INDUCED GENETIC EFFECTS IN SUNFLOWER AS INFLUENCED BY BORON NUTRITION. John Skok.

Results are reported from a study of the effects of boron nutrition on x-radiation-induced genetic effects in sunflowers. (C.H.)

1224 ANL-6200(p.47-8)
Argonne National Lab., Ill.
CHEMICAL PROTECTION: THE COMPARATIVE EFFECTIVENESS AGAINST FISSION NEUTRONS AND Co^{60} GAMMA RAYS OF AET ADMINISTERED ORALLY TO MICE BEFORE IRRADIATION. Howard H. Vogel, Jr., Norman A. Frigerio, and Donn L. Jordan.

Results are reported from a comparison of the protective effects of 5,2-aminoethylisothiuronium bromide (AET) against injury from fission neutrons and Co^{60} γ rays in mice. (C.H.)

1225 ANL-6200(p.49-50)
Argonne National Lab., Ill.
RADIATION RECOVERY: FRACTIONATION OF Co^{60} GAMMA-IRRADIATION WITH BRIEF INTERVALS (MIN-

UTES) BETWEEN PAIRED EQUAL DOSES TO 4-DAY CHICK EMBRYOS IN OVO. Howard H. Vogel, Jr., and Donn L. Jordan.

The fractionation of Co^{60} γ irradiation, with intervals of a few minutes between paired equal doses, allowed a majority of 4-day chick embryos to survive early mortality after exposure to doses in the lethal range. (C.H.)

1226 ANL-6200(p.51-5)
Argonne National Lab., Ill.
PILOT STUDY OF SUBACUTE IRRADIATION FOR FUTURE FAST NEUTRON AND GAMMA-RAY EXPOSURES. II. LONGEVITY AFTER 13 DAILY EXPOSURES. Howard H. Vogel, Jr., and Donn L. Jordan.

Preliminary results are reported from a study of the effects of 13 daily exposures to small doses of fission neutrons or Co^{60} γ rays on the survival time of mice. Results are compared with those from a study of the effects of long-continued chronic exposures. (C.H.)

1227 ANL-6200(p.56-9)
Argonne National Lab., Ill.
FERTILITY OF YOUNG ADULT FEMALE CF NO 1 MICE EXPOSED TO 13 DAILY DOSES OF FISSION NEUTRONS (3–52 RADS DAILY). Howard H. Vogel, Jr., Donn L. Jordan, Richard R. Barhorst, and Nicholas Bink.

Results are reported from mating tests carried out for 8 months after exposure of female mice to daily doses of fission neutrons for 9 or 13 days. Female mice exposed to daily doses as low as 6.5 rads delivered on 9 consecutive days showed a decrease in both number of pregnancies and the average litter size. Data are tabulated. (C.H.)

1228 ANL-6200(p.66-71)
Argonne National Lab., Ill.
SEQUELAE OF FISSION NEUTRON AND Co^{60} GAMMA IRRADIATION OF MICE. I. RESULTS 325 DAYS AFTER EXPOSURE. Miriam P. Finkel and Birute O. Biskis.

Preliminary results are reported from a comparison of the effects of internal and external irradiation in mice through 325 days after exposure. Data are included on the effects of exposure to fission neutrons or to Co^{60} γ rays in a γ-neutron radiation chamber. (C.H.)

1229 ANL-6200(p.72-7)
Argonne National Lab., Ill.
A STUDY OF THE EARLY STAGES OF COLONY FORMATION FOLLOWING HIGH DOSES OF X-RAYS TO DRY SPORES OF BACILLUS MEGATERIUM. E. L. Powers and Barbara F. Kaleta.

An investigation was made of germination and the early cell division of irradiated and nonirradiated bacterial spores in an attempt to define the nature of the biological damage that leads to loss of colony formation ability. The process of germination was observed by a micro method and separated into five stages. X-irradiated spores of Bacillus megaterium were observed to follow the same process of germination as the nonirradiated spores during the first hour of incubation. After this time, the survivors in an irradiated sample continued to germinate and divide at about the same rate as the nonirradiated spores up to the point of visible colony formation. (C.H.)

1230 ANL-6200(p.82-8)
Argonne National Lab., Ill.
MICROINJECTION STUDIES ON AMOEBAE AFTER THEIR EXPOSURE TO A SUPRALETHAL DOSE OF X-RAYS OR γ-RAYS. Edward W. Daniels.

The survival of the giant amoeba Pelomyxa illinoisensis exposed to a supralethal dose of x or γ rays was not affected by the injection of a number of chemical compounds and homogenate preparations. (C.H.)

1231 NP-9001
Sweden. Kungliga Karolinska Medico-Kirurgiska Institutet. Radiofysiska Institutionen, Stockholm.
LEVELS OF IONIZING RADIATIONS ORIGINATING FROM NATURAL AND ARTIFICIAL SOURCES, WITH SPECIAL REFERENCE TO IRRADIATION OF THE HUMAN GONADS. Rolf M. Sievert. [1956?]. 15p.

Levels of ionizing radiations originating from natural and artificial sources were investigated with special reference to irradiation of human gonads. The sources evaluated were cosmic radiation; gamma radiation from the naturally occurring amounts of radium, thorium, and potassium in the earth's crust, and from fission products; radiation originating from the body content of radioactive elements, principally potassium-40, possibly radium and strontium-90, cesium-137, and other fission products; and roentgen irradiation of patients undergoing radiologic examination or treatment. (M.C.G.)

1232 NYO-9512(p.6-7)
Massachusetts. General Hospital. John Collins Warren Labs., Boston.
STUDIES ON THE RELATIONSHIP BETWEEN NUCLEIC ACID METABOLISM AND CELL DIVISION IN IRRADIATED TISSUES.

A study was made of the effect of ionizing radiation on DNA synthesis in synchronously growing tissues using Tetrahymena pyriformis. By exposing cultures to 60 kilorads in 2 sec at various growth stages, a direct and prompt inhibitory effect on DNA synthesis was demonstrated. A continuous and linear synthesis of DNA throughout the growth cycle was observed. It was also found that radiosensitivity of DNA synthesis is not related to any particular growth phase. (T.R.H.)

1233 NYO-9512(p.8)
Massachusetts. General Hospital. John Collins Warren Labs., Boston.
LATENT INJURY AND REPAIR IN RAT LIVER INDUCED TO REGENERATE AT INTERVALS AFTER X-IRRADIATION.

Studies of mitotic abnormalities in livers of irradiated mice were made. Following 365 or 600 r whole-body irradiation, a delay in the onset of DNA synthesis and mitotic activity and an inhibition of these two parameters were observed in regenerating rat liver. It appears that processes of recovery are accelerated by increased cell proliferation. (T.R.H.)

1234 NYO-9512(p.12-13)
Massachusetts. General Hospital. John Collins Warren Labs., Boston.
EFFECT OF RADIATION ON WOUND CONTRACTION.

In studies of wound contraction under irradiation, the process was found to lie in a narrow zone underlying the advancing skin edge. (T.R.H.)

1235 TID-6349
Chicago. Univ.
THE EFFECT OF LOCALIZED X-IRRADIATION ON ANTIBODY FORMATION AND ANTIGEN LOCALIZATION. THE SITE OF ANTIBODY FORMATION. Final Report [for] June 1, 1951–June 30, 1960. W. H. Taliaferro. 30p. Contract AT(11-1)-175. OTS.

Progress is reported in studies on the production of red-sheep-cell hemolysins in rabbits, the biochemistry and radiosensitivity of antibody formation, the effects of ionizing radiations on hemolysin synthesis, the character-

ization of Forssman hemolysins, the dynamics of the hemolysin response, the biological action of antibodies, and the distribution of antigen. A list is included of papers published or in press. (C.H.)

1236 TID-6615
Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.
PHYSIOLOGICAL STUDIES ON CONGENITAL DEFORMITY IN MICE. MECHANISM OF ACTION OF RADIATION AND RADIOMIMETIC TREATMENTS. Progress Report and Sixth Renewal Proposal [for] September 1, 1959 – August 31, 1960. Charles P. Dagg and Meredith N. Runner. Oct. 1, 1960. 23p. Contract AT(30-1)-1762. OTS.

A study was made of the effects of radiation and radiomimetic treatments on mammalian embryos under controlled genetic conditions. Four strains of mice were given doses of 130 r of x rays at various intervals after copulation. The litters were examined for skeletal defects. The axial skeleton from the cervical through the sacral region was the most susceptible organ system. Sensitivity to production of malformed vertebral elements did not vary with strains. The pattern of distribution of deformities within the column was a unique characteristic of the strain. (T.R.H.)

1237 TID-6729
Marquette Univ., Milwaukee. School of Medicine.
RELATION OF RICKETTSIAL AND VIRAL INFECTIONS TO RADIATION INJURY. Progress Report and Proposed Program [for] Period January 1, 1960–December 31, 1960. Oct. 1960. Donald Greiff. 53p. Contract AT(11-1)-596. OTS.

Three reports of progress are included: Relation of Rickettsial and Viral Infections to Radiation Injury; The Effects of Glycerol, Freezing and Storage at Low Temperatures and Drying by Vacuum Sublimation on Oxidative Phosphorylation by Mitochondrial Suspensions; and The Level of Lactic Dehydrogenase Activity as an Indicator of the Growth of Influenza Virus in the Embryonate Egg. Separate abstracts have been prepared for each. (T.R.H.)

1238 TID-6729(Paper 1)
Marquette Univ., Milwaukee. School of Medicine.
[THE EFFECTS OF CENTRIFUGATION, PURIFICATION AND INOCULUM AND TYPE OF SERUM ON THE INFECTIVITY OF CELLS IN TISSUE CULTURE BY RICKETTSIA MOOSERI]. Paper 1 of RELATION OF RICKETTSIAL AND VIRAL INFECTIONS TO RADIATION INJURY. 9p.

Progress is reported on: the effects of centrifugation, purification and inoculum, and type of serum on infectivity of cells in tissue culture on Rickettsia mooseri; levels of enzyme activities as an indicator of the growth of influenza virus and rickettsia in embryonate eggs; effects of ionizing radiation on dried virus and cellular particulates; and further studies on the effects of x rays and β rays (tritium) on the growth of influenza virus in isolated chorioallantoic membrane preparations. (T.R.H.)

1239 TID-6833
Purdue Research Foundation, Lafayette, Ind.
TECHNICAL PROGRESS REPORT FOR FEBRUARY 1, 1960–JANUARY 31, 1961. A. B. Burdick. Oct. 31, 1960. 4p. Contract AT(11-1)-856. OTS.

Partial hydration protection against radiation injury to seeds and pollen was studied. Development work for this study and production of hybrid seed stocks for this study and for a study of mutation at specific loci are briefly reported. (T.R.H.)

1240 TID-6874
Chicago. Univ.
IRRADIATION EFFECTS ON THE CENTRAL NERVOUS SYSTEM. Progress Report covering Period January 1, 1960 to date. V. Nair, D. Palm, and Lloyd J. Roth. Sept. 30, 1960. 8p. Contract AT(11-1)-847. OTS.

A method was developed for determining the relative vascularity of certain anatomical areas of the brain and other organs of the rat. Injections in the tail vein of 10 μc/100g of I^{131}-labeled human serum albumin were used. After 15 min 1 ml of blood was drawn, and the animal was sacrificed by freezing. The brain was removed and sectioned, and the sections were homogenized and counted in a well type scintillation counter. It was found that the vascularity of the central nervous system of the rat is not uniform, and interpretations based on an average of 0.024 ml of blood per gram of brain may need reconsideration. There is a variation from animal to animal. (T.R.H.)

1241 TID-6877
New Hampshire. Univ., Durham.
RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. William R. Lee. 1959. 3p. Contract AT(30-1)-2315. OTS.

An improved technique for partial-body irradiation of bees is described. The parental queen is placed in a block of lead with the last two visible segments of the abdomen extending into a 50 kv x-ray beam. The technique enables comparison to be made between control and irradiated groups, all of which were progeny of the same queen and haploid male. Experimental irradiations using this technique to study viability of mutations are described. Some results of the study are reported, but data are insufficient to make conclusions. The technique is very successful. (T.R.H.)

1242 TID-6878
Syracuse Univ., N. Y.
THE USE OF IONIZING RADIATION FOR STUDYING ENZYME COMPLEXES. Final Report for April 1, 1958–September 30, 1960. Trevor Robinson. 7p. Contract AT(30-1)-2144. OTS.

An investigation was made of the possibility that certain compounds might protect enzymes against irradiation damage by forming complexes rather than competing with the enzyme for radioinduced free radicals. Aqueous solutions of aldolase, hexokinase, and alcohol dehydrogenase were irradiated and inactivation yields were measured. Results are presented and discussed for the alcohol dehydrogenase as well as for other related studies. (T.R.H.)

1243 USNRDL-TR-455
Naval Radiological Defense Lab., San Francisco.
STUDIES ON THE PATHOGENESIS OF NEPHROSCLEROSIS IN THE MOUSE FOLLOWING WHOLE-BODY X-RADIATION. V. J. Rosen, L. J. Cole, and P. L. Roan. Aug. 19, 1960. 13p.

A progressive glomerular lesion is described in the LAF_1 mouse following sublethal whole-body x irradiation (690 rad). The lesion is manifested by the proliferation of large, irregular pleomorphic cells in the intercapillary space and by the subsequent deposition of PAS positive material in these areas and in the glomerular basement membranes. The lesion first appears after a latent period of about 20 weeks and progresses rapidly from that time. It is suggested that similar but less severe lesions seen in nonirradiated aged LAF_1 mice may imply that the irradiation lesion is a manifestation of a "premature aging" phenomenon in the kidney although acceleration of what may be a spontaneous form of glomerulitis must be considered. (auth)

1244 AEC-tr-4086
Akademiya Meditsinskikh Nauk S.S.S.R.
BIOLOGICAL EFFECT OF SMALL DOSES OF IONIZING RADIATION. (O Biologicheskom Deĭstvii

Ioniziruyushcheĭ Radiatsii v Malykh Dozakh). V. A. Gubin and Yu. I. Moskalev. Translated by Lydia Venters (Argonne National Lab.) from United Nations Report A/AC.82/G/L.327. 40p. JCL or LC.

Results are reviewed from a number of studies on the biological effects of small doses of radiation. Doses of the order of 0.05 to 5.0 r are considered small. 102 references. (C.H.)

1245 AEC-tr-4087
Akademiya Nauk S.S.S.R.
SOME MECHANISMS OF FORMATION OF RADIOISOTOPE-INDUCED OSTEOGENIC SARCOMAS. (O Nekotorykh Zakonomernostyakh Vozniknoveniya Osteogennykh Sarkom Indutsirovannykh Radioizotopami). V. N. Strel'tsova. Translated by Lydia Venters (Argonne National Lab.) from United Nations report A/AC.82/G/L.328. JCL and LC.

Three hundred and twelve cases of osteogenic sarcoma appeared in a group of 1565 rats of both sexes and 19 cases of osteogenic sarcoma appeared in 46 rabbits surveyed for 200 days after the injection of Sr^{89}, Sr^{90}, Ba^{140}, Pu^{239}, Y^{91}, Ce^{144}, or Pm^{147}. Strontium, barium, plutonium, and yttrium isotopes accumulated in bones in substantial quantities. Cerium and promethium were deposited mostly in the liver, with smaller amounts in the skeleton. It was found that when the isotopes contained in nonseparated solutions of fission products entered on organism, they were distributed in it according to the distribution mechanisms for each individual element. The frequency of formation of the osteogenic sarcomas, type, and degree of cell differentiation were found to be proportional to the amount of the isotope accumulated in the organisms. The life span of animals with bone tumor and the frequency of their metastatic spread were found to be inversely proportional. 46 references. (C.H.)

1246 AEC-tr-4088
Akademiya Meditsinskikh Nauk S.S.S.R.
TUMORS IN RATS INDUCED BY INTRAPERITONEAL ADMINISTRATION OF PLUTONIUM NITRATE (Pu^{239}). (Opukholi u Krys Voznikshie Posle Vnueribryushinnogo Vvedeniya Azotnokislogo Plutoniya (Pu^{239})). Z. M. Bukhtoyarova and V. K. Lemberg. Translated by Lydia Venters (Argonne National Lab.) from United Nations Report A/AC.82/G/L.325. 16p. JCL or LC.

Results are reported from a study of the formation of osteogenic sarcomas in rats following the intraperitoneal injection of various doses of Pu^{239}. (C.H.)

1247 AEC-tr-4090
Akademiya Nauk S.S.S.R.
SENSITIVITY OF THE NERVOUS SYSTEM TO LOW-LEVEL RADIATION. (O Chuvstvitel'nosit Nervnoĭ Sistemy k Slabym Radiatsionnym Vozdeĭstviyam). M. N. Livanov and I. N. Kondrat'eva. Translated by Lydia Venters (Argonne National Lab.) from United Nations Report A/AC, 82/G/L.324. 16p. JCL or LC.

Results are reported from a series of studies on the effects of low-level radiation on the function of the nervous system. Single exposures of 2 to 10 r were shown to induce traces of function changes in the nervous system. Some functional changes were delayed as much as 2 weeks following exposure. Correlation between the limit of sensitivity of the nervous system and the limits of its effect and reaction mechanisms involved are discussed. 33 references. (C.H.)

1248 JPRS-5649(p.46-56)
PERIPHERAL BLOOD CHANGES FROM THE CHRONIC EFFECT OF SMALL DOSES OF IONIZING RADIATION. I. A. Gribova and E. A. Solov'eva (Ye. A. Solov'yeva). Translated from Med. Radiol. 6, No. 6, 17-24(1960).

Because of contradictory evidence in the literature, a study was made of people who in the course of their work had been exposed to ionizing radiation. Blood studies were performed on a large number of such people between 1956 and 1958, both male and female, ages 20 to 40. Three to five flood analyses, hemoglobin determination, red blood count, white blood count, recticulocyte count, platelet count, differential white count, sedimentation rate, and bleeding time by the Duke method were studied. For controls, 100 healthy middle-aged men not exposed to radiation were studied. The earliest reaction of the peripheral blood after the chronic effect of small doses of ionizing radiation is an instability of some of its indices. Reticulocyte count and bleeding time increase early. Unstable leukopenia because of neutropenia and thrombocytopenia are later indices and are found when the initial signs of the radiation effect have been diagnosed clinically. (T.R.H.)

1249 JPRS-5649(p.57-62)
SOME PHYSICOCHEMICAL AND CHEMICAL INDICES OF THE BLOOD DURING THE CHRONIC EFFECT OF SMALL DOSES OF IONIZING RADIATION. L. E. Gorn. Translated from Med. Radiol. 6, No. 6, 25-6(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22778.

1250 JPRS-5649(p.92-101)
BLOOD SERUM LACTIC DEHYDROGENASE AFTER IRRADIATION. V. Volek and Z. Dienstbier. Translated from Med. Radiol. 6, No. 6, 39-42(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22779.

1251
TRANSFER OF HOMOLOGOUS THORACIC DUCT LYMPHOCYTES TO IRRADIATED RATS. D. O. Anderson and D. M. Whitelaw (Univ. of British Columbia, Vancouver). Am. J. Physiol. 199, 824-8(1960) Nov.

Lymphocytes from the thoracic duct of rats were injected intraperitoneally into homologous rats previously exposed to 900 rads of total-body radiation. Repeated white blood cell counts, platelet counts, polychromatophilia counts and reticulocyte counts provided no evidence that the transplanted cells were able to repopulate the bone marrow. (auth)

1252
COMPARISON OF PHOTOTROPH MUTANTS INDUCED BY X AND U. V. RAYS IN ESCHERICHIA COLI B/r TRY⁻. T. Kada, E. Brun, and H. Marcovich (Institut Pasteur, Paris). Ann. inst. Pasteur 99, 547-66(1960) Oct. (In French)

Some x-ray and α-ray induced phototrophs in a tryptophane-requiring strain of E. coli B/r grown in broth are not expressed in agar. Broth must be present for at least 1 hr for optimal expression. The potential mutants induced by UV are lost by 1 hr in a minimal medium before plating in a broth containing one. This effect is very small for ionizing radiations. The UV-induced mutability, but not the x-ray, is restorable by visible light. X rays are genetically 1000 times more efficient than UV for killing, but 1000 times less efficient for mutations. (T.R.H.)

1253
RADIO-INDUCED HEREDITARY STERILITY PHENOMENA IN PLANTS. W. Gottschalk (Universität, Bonn). Atompraxis 6, 341-7(1960) Sept. (In German)

The morphological relations of 31 flower mutants that appeared after x-ray treatment of dormant seeds of P. sativum are discussed. Only one of these mutants is

fertile, three others show a significantly reduced fertility, and the rest are sterile. In 2 mutants the transition from the vegetative to the reproductive phase does not take place. Other mutants show functionable reproductive organs, but the mutual position of anthers and the stigma was altered by the action of mutated genes. In these plants self-fertilization is thus prevented. Gynaeceum seems to be extremely susceptible to such effects. Ten different genes were found which cause a nearly equal defect in uniting the carpel edges. In several mutants, instead of a single flower, an inflorescence of several flowers is formed by the growing point. Most of the mutated genes show a pleiotropic activity, partly affecting the shape of the flower itself, but partly affecting other plant organs as well. (auth)

1254

THE BEHAVIOR OF FORMED BLOOD ELEMENTS IN CHRONIC IRRADIATION. A QUANTITATIVE AND QUALITATIVE ANALYSIS FOR THE DIAGNOSIS OF RADIATION INJURY. III. E. H. Graul and K. Damminger (Universität, Marburg, Ger.). Atompraxis 6, 357-61(1960) Sept. (In German)

A report on the experiments in which animals were exposed to slight doses of chronic irradiation is given. A special analysis is given of the erythrocyte count curves. The high accuracy of the electronic counting method makes it possible to demonstrate injury with doses of above 0.5 r/day. In addition, the courses of the leucocyte curves and leucocyte resistance values are examined after electronic counting, as well as the thrombocyte counts and thrombocyte resistance values after microscopic counting. It is pointed out that the thrombocyte count and resistance value must be considered as the most sensitive indicator of radiation injury, and thus are very important diagnostically. (auth)

1255

THE ENZYMIC COMPOSITION OF NUCLEI ISOLATED FROM RADIO-SENSITIVE AND NON-SENSITIVE TISSUES WITH SPECIAL REFERENCE TO CATALASE ACTIVITY. W. A. Creasey (Oxford Univ.). Biochem. J. 77, 5-12(1960) Oct.

A study was made of the enzyme content of cell nuclei isolated from both radiosensitive and nonsensitive tissues of the rat and from pigeon liver in an attempt to demonstrate a biochemical basis for differences in radiosensitivity. Catalase activity was found to be much greater in the nuclei from nonsensitive tissues. Total-body radiation led to a decrease in nuclear-catalase content, but no significant change occurred in the activity of whole lymphatic tissues. The nuclear effect could be correlated with the dose of radiation received. Radiation of nuclear suspensions of thymus led to a decrease in activity. (auth)

1256

PHYSICAL STUDIES ON POX VIRUSES. I. INACTIVATION OF VACCINIA VIRUS INFECTIVITY WITH LOW-ENERGY ELECTRONS. J. F. McCrea, John W. Preiss, and Jean O'Loughlin (Yale Univ., New Haven). Biophys. J. 1, No. 1, 43-53(1960) Sept.

Vaccinia virus was irradiated in vacuo with low-voltage electrons of restricted ranges. It was found that the pock-forming ability of the virus was not decreased after bombardment with electrons penetrating 100 A beneath the virus surface. There was very slight reduction in titer with large doses of electrons penetrating 330 A, but a sudden marked drop in infectivity occurred after exposure to electrons penetrating 500 to 700 A. Electrons of higher energies, including those capable of penetrating the virus particle completely, did not produce significant further fall in infectivity titer. It is concluded that a highly radiation-sensitive unit essential for pock formation is situated 500 to 700 A beneath the surface of the virus particle, possibly in the form of a shell. The relation of this finding to the known structure of the virus and to other radiation data on the dimensions of the infectious unit is discussed. (auth)

1257

EFFECT OF IONIZING RADIATION ON THE LUMINOUS BACTERIA B. ISSATCHENKOI. RADIOBIOLOGICAL PROBLEM OF THE TIME FACTOR AND OF RECOVERY. A. A. Zotikov (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation) 5, 197-202(1960).

Results of experiments with x irradiation of the luminous bacteria B. issatchenkoi showed that after irradiation with doses of the order of 100 to 200 kr, there occurs a partial recovery of activity of the light-emitting enzymatic luciferin-luciferase system. However, this recovery is temporary and transitory. The results of experiments with transient and prolonged radiation of luminous bacteria, the ratio of dose rates was 1:45, showed that protracted irradiation depresses the luminescence about twice as strongly as transient irradiation, so that an inverse time factor is present. The dose-effect curve was plotted by the usual method of colony count. The curve was exponential. The dose depressing multiplication by 50 per cent (LD50) was 3 kr. A dose-luminescence curve for the colonies of bacteria was plotted. The curve was exponential. The dose depressing the luminescence of the bacteria which formed colonies by 50 per cent measured 24 hr after irradiation was 3500 r. It has been shown that doses of the order of 1.5×10^5 r depress luminescence by 80 to 85 per cent of the original value of the intensity of luminescence of the bacteria when measured directly after irradiation. (auth)

1258

THE "AFTEREFFECT REACTION" IN IRRADIATED ERYTHROCYTES. I. I. Gitel'zon and I. A. Terskov (Inst. of Physics, Academy of Sciences, Krasnoyarsk, USSR). Biophysics (U.S.S.R.) (English Translation) 5, 207-13(1960)

The basic pattern of radiation aftereffect observed in more complex cells and whole organisms was detected in erythrocytes. The development of such a process in erythrocytes which are devoid of a nucleus and protoplasmatic organoids shows that the radiation aftereffect may also develop in the absence of these structures. (auth)

1259

INFLUENCE OF IRRADIATED PLANT SEEDLINGS ON THE GROWTH OF UNIRRADIATED SEEDLINGS. V. I. Korogodin and T. G. Mamedov (Lomonosov State Univ., Moscow). Biophysics (U.S.S.R.) (English Translation) 5, 213-17(1960).

The detected inhibition of unirradiated by irradiated seedlings is characterized by the presence of an optimum dose. The factor of inhibition apparently is not a direct product of irradiation but appears as a result of disturbances in the metabolism of the irradiated plants. The inhibitory influence of irradiated seedlings on unirradiated ones bears a relation to the changes in pH and the redox potential of the medium in which the seedlings are grown. (auth)

1260

REACTION OF THE PLANT TO INJURY AFTER X-IRRADIATION. I. M. Vasil'ev and B. G. Zhukov (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation) 5, 217-22 (1960).

Reactions of irradiated plants to subsequent injury are described. (C.H.)

1261
STUDY OF THE ELECTRICAL CONDUCTIVITY OF THE LIVER OF IRRADIATED ANIMALS. E. (Ye.) V. Burlakova and O. R. Kol's (Lomonosov State Univ., Moscow). Biophysics (U.S.S.R.) (English) Translation) 5, 223-31(1960).

The effect of γ rays of radioactive cobalt on the value of the high frequency and low frequency resistance and capacitance and on the dispersion of resistance of the liver tissues of white mice was studied. The action of lethal doses of γ rays caused a decrease in the dispersion of resistance, the low frequency resistance and capacitance and an increase in the high frequency resistance of the liver of white mice as compared with the corresponding parameters in normal animals. The experimental results suggest that in the liver of irradiated animals there occurs an increase in the amount of low molecular weight substances and a decrease in the number of free ions. With long survival of the liver in the control and irradiated white mice there was a continuous change in the electrical parameters, namely increase in the dispersion of resistance, the values for the high frequency and low frequency resistance and a reduction in capacitance. On prolonged survival of the liver of irradiated animals the change in the electrical parameters reached large absolute values and developed at a higher rate than for the surviving liver of the control animals; this seems to suggest intensified processes of autolysis in the tissue of irradiated animals. (auth)

1262
ROLE OF THE TIME FACTOR IN DAMAGE DUE TO RADIOACTIVE ISOTOPES. Yu. (Iu.) I. Moskalev. Biophysics (U.S.S.R.) (English Translation) 5, 231-8(1960).

The biological action of radioactive isotopes depends on the dose, dose rate, and the type of emission. On injury with Sr^{90} and Ce^{144} there exist doses with a temporary stimulatory effect, others which do not affect the natural life span of the rats, and others which shorten it. On prolonging the time of delivery of the doses of radiation of 8.4 to 27.3 krad, the effectiveness of Ce^{144} as judged by the duration of life of rats is increased; on prolonging the delivery of higher doses, it falls. After damage by Sr^{90} the frequency of onset of osteosarcomas falls, and that of leukemia increases, on lowering the dose rate. As distinct from Sr^{90}, with Pu^{239} the frequency of osteosarcoma development increases on reducing the dose rate. As compared with β emitters the damage induced by α emitters is less readily restored and is better summated on prolongation of the action. (auth)

1263
SERIAL IRRADIATION OF MOUSE TUMOURS: SOME CHANGES IN HISTOLOGY AND CYTOLOGY. A. E. G. Pearson (Mount Vernon Hospital, Northwood, Middx., Eng.). Brit. J. Cancer 14, 200-5(1960) June.

Histological and cytological comparisons were made on parent and serially irradiated lines of sarcoma 37 and two homologous tumors in RIII strain inbred mice. The two homologous tumors showed no marked changes after serial irradiation. Regions of increased anaplasia were apparent in the adenocarcinoma MV212 after serial irradiations. Histological changes were apparent in the cortex of sarcoma 37 tumors subjected to sublethal doses at each irradiation stage. In this same line a proportional increase occurred in certain cells having a characteristic nuclear morphology. Both of these changes appeared to be progressive during the establishment of the irradiated line and were not altered by sub-line passage without further irradiation treatment. The significance of these changes is discussed in relation to radiosensitivity, cell degeneration, and invasive properties. A correlation is suggested between nuclear morphology and ploidy. (auth)

1264
MUTATION INDUCED IN GERM CELLS OF THE FOETAL FEMALE MOUSE. T. C. Carter (Medical Research Council's Radiobiological Research Unit, Harwell, Berks, Eng.). Genet. Research 1, 59-61(1960) Feb.

In the absence of data concerning the genetically effective radiation dose to human germ cells, studies were made of induced mutations in the mouse, using the specific-locus method. Earlier studies of mutations induced in spermatogonia of the adult male were extended to include those induced in spermatogonia of fetal males, in postspermatogonial cells of adult males, and in oöcytes of adult females. The main conclusions reached are discussed in connection with radiation intensity and germ-cell stage. Data are tabulated for mutation at seven specific loci in germ cells of the female mouse and for comparison of induced mutation rate in the fetal female with those in the adult. It is clear that the germ cells of the fetal female mouse, irradiated under the conditions of the experiment, are not grossly more sensitive than those of the adult. (B.O.G.)

1265
RADIOSENSITIVITY IN PLANTS. IV. EXPERIMENTS WITH SEVERAL MUTANT STRAINS OF EINKORN WHEAT. Tarô Fujii (National Inst. of Genetics, Japan). Idengaku Zasshi 35, 110-19(1960) Apr. (In English)

Three kinds of chlorophyll mutants and three morphological mutants of einkorn wheat were subjected to γ and x rays. Their radiation susceptibility was examined in X_1 and in X_2 seedlings. Radiation sensitivity of mutant strains in the X_1 generation, concerning germination or survival rate, plant height, and fertility was not much different from that of the normals. In the X_2 generation the frequency of chlorophyll mutation in mutant strains was the same when their germination rate was good. It became low when the percentage of nongerminating heads was high. Addition of radiation injury or additional gene mutation might be the cause of the variable viability in the X_2. Mutation spectrum of the mutated strains seems to be similar to that of the normal strain. About half of the chlorophyll mutants were albina. Mutations in one major gene seem to bring about a similar response to radiation as that of the normals. (auth)

1266
ELECTROPHORETIC ANALYSES OF SERA FROM MICE PROTECTED FROM LETHAL X-RADIATION. I. C. Shekarchi and T. Makinodan (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol. 2, 353-60(1960) Oct. (In English)

No significant change in the serum-protein concentration or composition was observed among the AET-950 and 950 r-IBM mice. A decrease in the albumin concentration and an increase in the globulin concentration was seen after 950 r only. Associated with the secondary loss in body weight among the 950 r-RBM mice is a decrease in the albumin/globulin ratio, extending from the second through the seventh weeks, and caused by an increase in the lipoprotein concentration and a decrease in the albumin concentration. (auth)

1267
FACTORS IN THE INACTIVATION OF T2 BACTERIOPHAGE AND MONO-COMPLEX BY IONIZING RADIATIONS. I. THE EFFECTS OF OXYGEN. P. Howard-Flanders and P. Jockey (Univ. of California, Berkeley). Intern. J. Radiation Biol. 2, 361-9(1960) Oct. (In English)

The rate of inactivation of T2 phage and the T2 E. coli B

mono-complex by 50 kv x rays or by γ rays was investigated. The phage was protected from indirect radiation action by nutrient broth or thiourea, and the irradiations were carried out in the presence or in the absence of oxygen. It was found that oxygen had very little effect on the inactivation of the phage, but that the presence of oxygen doubled the rate of inactivation of the complex. This change in the oxygen effect appears to occur as soon as the phage-DNA enters the bacterial cytoplasm and is independent of whether or not cyanide is added before adsorption. The results are discussed in terms of the reactions of a radiation-induced carbon radical in the phage-DNA which may combine with molecular oxygen and become inactivated, react with a cytoplasmic hydrogen-atom donor and regain the active configuration, or become inactivated by a third unknown process if neither oxygen nor a hydrogen donor is present. (auth)

1268

EFFECT OF DOSE-RATE AND FRACTIONATION OF X-RAY DOSE ON ACUTE LETHALITY IN MICE. J. A. H. Brown, M. J. Corp, and D. R. Westgarth (Medical Research Council, Radiobiological Research Unit, Harwell, Berks, Eng.). Intern. J. Radiation Biol. 2, 371-81(1960) Oct. (In English)

The difference in x-ray dosage needed to kill mice acutely when the exposure varied from 12 min to 6 hr and the dose rate from 3 to 55 rads/min was studied. The effect of giving the dose divided into 72 separate fractions was also described. The dose needed to kill depends almost wholly on the over-all exposure time, i.e., for continuous radiation the actual exposure time or for fractionated doses the time between the start of the first dose and the end of the last one. The longer the duration of exposure the larger the dose required; changes in dose rate and number of fractions appeared to be of no consequence. Two different multiple-regression equations, expressed in terms of dose and time only, provide an equally effective description of the response. Possible mathematical models leading to each of these equations were suggested. It seems clear, however, that experimental data of the kind reported here cannot provide critical tests of current ideas about the rate of recovery from radiation. (auth)

1269

POLYVINYLPYRROLIDONE LABELLED WITH ^{131}I AS AN AGENT FOR THE DIAGNOSIS OF RADIATION INJURY IN RATS. M. F. Sullivan (General Electric Co., Richland, Wash.). Intern. J. Radiation Biol. 2, 393-8(1960) Oct. (In English)

Following exposure of the gastrointestinal tract of the rat to x rays, either in situ or after being surgically exteriorized, plasma albumin was markedly decreased. Using a labeled plasma-protein substitute, polyvinylpyrrolidone, we have demonstrated that this substance, and presumably plasma protein as well, is lost through the intestinal wall in amounts proportional to the radiation dose absorbed by the gastrointestinal tract. (auth)

1270

COMPARISON OF THE BIOLOGICAL EFFICIENCY OF FAST NEUTRONS AND CAESIUM GAMMA-RAYS ON "AUGUST" RATS. Roger Ghys (Laval Univ., Quebec). Intern. J. Radiation Biol. 2, 399-406(1960) Oct. (In English)

The relative biological efficiency of fast neutrons compared with cesium γ rays is equal to 3 on the lethality of August rats and equal to 4 as measured by the mean weight drop three days after irradiation. The timing of the various reactions appears to be the same in both cases, but death after fast neutron irradiation is mainly due to intestinal lesions and after cesium γ irradiation to bone-marrow lesions. Lethality does not, therefore, seem to be a very satisfactory criterion for comparing the efficiency of fast neutrons with x or γ rays. Any measure in rem derived from a lethality experiment might prove a very misleading guide when applied to accidental or therapeutic neutron irradiations in men. On the other hand, fast neutrons appear to be an ideal medium for the study of the mechanism of intestinal irradiation death and the digestive syndrome after nonlethal doses of radiations. (auth)

1271

ALTERATIONS IN RADIOSENSITIVITY OF THE HAEMOPOIETIC SYSTEM OF THE MOUSE PRODUCED BY EXTREME HYPOTHERMIA. L. Weiss (National Inst. for Medical Research, London). Intern. J. Radiation Biol. 2, 409-23(1960) Oct. (In English)

Mice were given whole-body x irradiation over the dose range 0 to 950 r. Some were irradiated at normal body temperatures and some at body temperatures of 1°C. Others were irradiated at normal body temperatures and then cooled to 1°C and subsequently resuscitated. The state of the hematopoietic system of such animals, as judged by examination of the bone marrow and by peripheral blood counts at periods of up to five days after irradiation, was studied. It is shown that hypothermia results in radioprotection of the leucocyte series and their precursors, and it is concluded that this protection is mainly due to concomitant severe hypoxia. (auth)

1272

EFFECTS OF IONIZING RADIATION ON RAT LYMPHOID TISSUE IN VIVO. E. L. Alpen, E. H. Cooper, and H. Barkley (United Oxford Hospitals; Univ. of Oxford; and St. Mary's Hospital, London). Intern. J. Radiation Biol. 2, 425-39(1960) Oct. (In English)

The effects of 300 rads whole-body x irradiation on desoxyribonucleic acid (DNA) synthesis in rat lymphoid tissue in vivo were studied by means of biochemical, autoradiographic, and histological techniques. The DNA synthetic process of the large and medium lymphocytes was shown to be more radiosensitive in vivo than in vitro. The reasons for the differences in sensitivity under these two conditions were discussed in the light of recent observations relating to the biphasic nature of the DNA synthetic cycle in rat thymocytes and human bone marrow. Histological and autoradiographic techniques have allowed the separation of effects due to population changes from those due to direct biochemical alteration. The study of control rats has revealed that the average generation time for the large and medium lymphocytes of the lymph nodes is 20 to 30 hr. Further evidence is presented in favor of a long life-span for the small lymphocytes. The question of reutilization of portions of the DNA molecule in the synthesis of new DNA was examined and evidence put forward in support of this concept. (auth)

1273

SOME EFFECTS OF HEAT AND IONIZING RADIATION ON SPORES OF BACILLUS MEGATERIUM. Hillel S. Levinson and Mildred T. Hyatt (Quartermaster Research and Engineering Center, Natick, Mass.). J. Bacteriol. 80, No. 4, 441-51(1960) Oct.

Spores of B. megaterium, irradiated at dose levels sufficient to destroy the capacity for cell division, may retain the ability to germinate in glucose. When suspensions of such irradiated spores germinate, they consume oxygen at a rate approximately equal to that of unirradiated spores, stain, lose dipicolinic acid, and decrease in optical density.

Higher levels of irradiation may alter spore permeability, simulating the responses characterizing germination even in the absence of glucose. The enhancement of radiation effects by subsequent heating and similarities in the effects of heat and radiation are noted. (auth)

1274

THE INFLUENCE OF CHEMOTHERAPY AND ACTIVE IMMUNIZATION ON THE COURSE OF DYSENTERY INFECTION IN MICE EXPOSED TO RADIATION. Li Gui (Gamalei Inst. of Epidemiology and Microbiology, Academy of Medical Sciences, USSR). J. Microbiol., Epidemiol. Immunobiol. (U.S.S.R.) (English Translation) 31, No. 1, 92-8(1960).

After mice became infected from small doses of Shigella flexneri var. newcastle, chemotherapy and immunization accelerated the elimination of bacteria from the internal organs of the animals. In such conditions immunization produced specific immunity. Exposure to 400 r suppressed the natural immunity and caused bacteraemia of pathogenic and non-pathogenic bacteria and suppressed resistance. Under these conditions chemotherapy and immunization still had a certain favorable effect on the animals. The mortality decreased, the formation of antibodies was enhanced, and bacteria were eliminated to a greater degree from the animals than in those animals which were infected and exposed to radiation but were not treated and immunized. After exposure of mice to a radiation dose of 300 r, immunization and chemotherapy were more effective than after exposure to a radiation dose of 400 r. (auth)

1275

IMMUNOLOGIC RESPONSE TO LYMPHOCYTIC CHORIOMENINGITIS VIRUS IN LETHALLY IRRADIATED MICE TREATED WITH BONE MARROW. Delta E. Uphoff and Victor H. Haas (National Cancer Inst., Bethesda, Md. and National Inst. of Allergy and Infectious Diseases, Bethesda, Md.). J. Natl. Cancer Inst. 25, 779-86(1960) Oct.

Lymphocytic choriomeningitis-immune, nonimmune, and lymphocytic choriomeningitis-carrier mice were exposed to lethal total-body x irradiation and protected by an inoculation of marrow from either immune or nonimmune donors. Subsequent challenge of the surviving chimeras with potent homologous virus established that, under the conditions of these experiments, immunity was a function of the host and not of the transplanted tissue. These observations and those of other workers may be explained by assuming that the preirradiation immunologic response of the chimeras usually persists after irradiation, but that immunologically competent marrow may either react against the host or impose its own immunologic mechanism upon the host. (auth)

1276

INITIAL REACTIONS OF THE HUMAN BODY TO THE EFFECT OF IONIZING RADIATION. M. N. Fateeva, A. I. Ponizovskaya, V. V. Sokolov, N. I. Gorbarenko, E. A. Denisova, and V. E. Ostapkovich (Central Roentgenological and Radiological Inst. for Medical Graduate Work, USSR). Med. Radiol. 5, No. 8, 3-7(1960) Aug. (In Russian)

Data relating to the initial reactions of the human organism to the action of ionizing ridiation are discussed. (auth)

1277

ON MYELOMATOSIS IN THE PERSONNEL OF X-RAY ROOMS. S. A. Reĭnberg. Med. Radiol. 5, No. 8, 7-9 (1960) Aug. (In Russian)

The incidence of occupational myelomatosis in the personnel of x-ray departments is considered. A survey was made of the pertinent literature. Three case reports are presented. (auth)

1278

THE REACTION OF THE SKIN TO BETA-IRRADIATION DURING THE USE OF APPLICATORS WITH RADIOPHOSPHORUS. B. M. Lebedev and E. A. Ievleva (Central Dermatological Venerological Research Inst. of the Ministry of Health, USSR). Med. Radiol. 5, No. 8, 13-14(1960) Aug. (In Russian)

Studies of the reaction of the skin to β irradiation during the employment of applicators with radiophosphorus are discussed. (auth)

1279

ELECTROPHYSIOLOGICAL INVESTIGATION OF AFFERENT SIGNALIZATION OF INTERNAL ORGANS IN X-RAY IRRADIATION OF THE ORGANISM. N. S. Delitsyna. Med. Radiol. 5, No. 8, 18-22(1960) Aug. (In Russian)

Acute experiments were staged on 24 cats. The action currents from the gastric branch of the splanchic nerve were recorded prior to and after x-ray irradiation (500 r) of the abdominal cavity. The data obtained attested to the change of afferent impulsation from the neuroreceptor apparatus of the gastrointestinal tract. The character of these changes immediately following irradiation could be different, depending upon the initial level of the activity. In high initial bioelectric activity, irradiation produced a drop of the amplitude and an increase of the frequency of the action currents. These changes usually reached their maximum 30 to 40 min following irradiation. After 24 hr, the action currents in the gastric branch of the splanchic nerve lost their usual character: group oscillation in a pulse rhythm became less distinct, while the impulsation acquired an incessant nature. This, apparently, testified to the presence of irritation of neuroreceptor apparatus of the gastrointestinal tract along with a certain desynchronization of their function. (auth)

1280

DEPENDENCE BETWEEN THE DOSE VALUE OF ANTENATAL IRRADIATION AND THE STATE OF THE HIGHER NERVOUS ACTIVITY. N. G. Mikhaĭlova (Inst. of Neurology, Academy of Sciences, USSR). Med. Radiol. 5, No. 8, 22-6(1960) Aug. (In Russian)

Antenatal irradiation from Co^{60} provoked a disturbance of the higher nervous activity in adult animals. The intensity of changes depended upon the dose of irradiation. Doses of 50 and 200 r (single whole-body irradiation on the 12th day of embryogenesis) were compared. The larger dose produced a profound inhibition of the main nervous processes, impairment of their balance and inertness. In irradiation with 50 r the decrease of the general cortical tone was less marked. It was noted that during irradiation with a dose of 200 r, apart from disorders of the higher nervous activity, there was also a reduced viability, congenital abnormalities (anomalies of the eyes), and lower weight indices. Such derangements were not observed with a dose of 50 r. (auth)

1281

SPECIFIC FEATURES OF THYMUS AFFECTION DURING THE ACTION OF IONIZING RADIATION. V. V. Kholin (Kirov Leningrad Inst. of Graduate Work in Medicine, USSR). Med. Radiol. 5, No. 8, 29-33(1960) Aug. (In Russian)

The features peculiar to the thymus affection in rats of varying age with acute radiation sickness were manifest, in the first place, by diverse markedness of restorative processes, which ran a considerably more rapid course in growing immature rats in contradistinction to mature animals. The end result of the restorative process depended upon the general course of radiation sickness. In view of

the great severity of the latter in growing rats a complete restoration of the thyroid gland was not observed. The initial changes, associated with the period of injury, ran a course identical in all age groups. (auth)

1282

CHANGES OF NUCLEIC ACIDS METABOLISM DURING INHALATION OF RADON AND SHORT-LIVING PRODUCTS OF ITS DECAY. T. B. Rakhmanova (State Inst. of Physiotherapy, USSR). Med. Radiol. 5, No. 8, 33-6(1960) Aug. (In Russian)

White rats were subjected to the action of radon and short-lived products of its decay. It was established that in single inhalation by rats (for 2 hr) of an air-radon mixture with radon concentration of 0.2 mc/l, the following changes of nucleic acids in the lungs and liver of these animals were observed. In the lungs there was an elevation of the content of both nucleic acids. Restoration of desoxyribose nucleic acid (DNA) as a rule, did not undergo any change, while the synthesis of ribonucleic acid (RNA) dropped slightly. Analogous changes were also noted in the liver, although with a somewhat larger inhibition of RNA synthesis. These data differ considerably from those cited in the pertinent literature concerning changes of nucleic acids under the effect of medium and large doses of ionizing radiation. Somewhat different data on the spleen, expressed by a sharp inhibition of RNA and DNA synthesis, although with the absence of distinct alterations in the content, were due apparently to a higher radiosensitivity of the spleen in comparison with the lungs and liver. In single two-hour inhalation of an air-radon mixture with 0.8 mc/l radon concentration, the animals develop a characteristic for radiation sickness syndrome with typical changes of nucleic acids, characterized by a sharp decrease of their content and a drop of synthesis. (auth)

1283

CHANGES OF THE CONTENT OF LIPOIDS, CHOLESTEROL, AND ASCORBIC ACID IN THE ADRENAL CORTEX OF RATS AFTER AFFECTION WITH POLONIUM OR X-RAY IRRADIATION. A. I. Chuchukalo. Med. Radiol. 5, No. 8, 37-41(1960) Aug. (In Russian)

After affection of rats with polonium (0.06 mc/kg), the content of lipoids and cholesterol in the adrenal cortex at the initial stage of the radiation process (3rd to 5th day) increased and that of the ascorbic acid decreased. At the peak of the disease (7th to 15th day) the lipoid and cholesterol content sharply dropped in all zones of the cortex, while that of the ascorbic acid rose. On the 20th day the general content of lipoids and cholesterol was the same, whereas the ascorbic acid level was somewhat lower than in normal animals. After x-ray irradiation (350 r) the above changes were marked to a lesser degree and developed somewhat earlier than following polonium injury. No lipoids or cholesterol were found in the adrenal cortex on the 20th day following irradiation with a dose of 600 r. (auth)

1284

ON THE FUNCTIONAL CONDITION OF ADRENAL CORTEX IN ACUTE RADIATION INJURY. Z. N. Nakhil'nitskaya. Med. Radiol. 5, No. 8, 41-6(1960) Aug. (In Russian)

The functional condition of adrenal cortex was studied in acute radiation injury. The working capacity of the skeletal and the smooth muscles served as an index of the cortical function. Experiments were conducted on x-ray irradiated cats given doses of 600 r. The author investigated the working capacity of gastrocnemius in electric stimulation of the sciatic nerve and of the smooth muscle of the nictitating membrane in stimulating the postganglionic fiber of the sympathetic nerve. A pronounced increase of the muscular working capacity was observed in 3 days after the irradiation with its subsequent decrease beginning from the 5th day. Definite changes in the nictitating membrane contractile reaction were revealed in the irradiated animals in stimulating the postganglionic fiber of the sympathetic nerve. Primary short phase of muscular relaxation in response to switching the current on with its subsequent contraction was noted after the irradiation. There was an additional contractile reaction in switching the current off. These phenemona are regarded as parabiotic. They were removed with decrease of the intensity of the stimulation. Changed frequency of the stimulation had no effect on the character of the reaction. There were no modifications in the character of the contractile reaction of the nictitating membrane in the irradiated animals in stimulating the preganglionic fiber. (auth)

1285

SOME DATA ON THE INFLUENCE OF IONIZING RADIATION UPON NUCLEIC SUBSTANCES OF THE ANIMAL ORGANISM. N. N. Demin. Med. Radiol. 5, No. 8, 63-71 (1960) Aug. (In Russian)

A review is given of new data on radioinduced changes in nucleic substances. Discussions of data on comparative stability of desoxyribonucleic acid and desoxyribonucleoprotein lability of nuclear substances in the nervous system, radiation effects on the intensity of nucleic acid synthesis, radiation effects on nucleic acid metabolism before any micromorphological disturbances are observed, changes in nucleic acid induced by indirect radiation factors, radioinduced changes in the content of nucleotides and nucleocytes in tissues, and desoxycytadine excretion in urine during radiation sickness are included. An extensive bibliography is given. (R.V.J.)

1286

EARLY CHANGES OF TISSUE PROTEINS IN LETHAL DOSES OF IONIZING RADIATION. T. A. Fedorova. Med. Radiol. 5, No. 8, 71-5(1960) Aug. (In Russian)

A review of data on radiation effects on tissue protein in animals shows that even less than lethal doses induce immediate and postradiative changes in organisms, which in turn cause secondary changes in metabolic processes and in protein transformations. (R.V.J.)

1287

THE PICTURE OF THE PERIPHERAL BLOOD AND THE CONDITION OF IMMUNOLOGICAL REACTIONS IN PERSONS SUBJECTED TO THE ACTION OF LOW DOSES OF X-RAYS. E. P. Shuvalova, T. G. Starkova, and V. M. Soldatova. Med. Radiol. 5, No. 8, 81(1960) Aug. (In Russian)

A brief account is given of the blood picture in x-ray technicians and personnel working in x-ray rooms. (R.V.J.)

1288

HETEROGENEITY OF CULTURES OF ESCHERICHIA COLI B/r. Howard I. Adler and Sara D. Haskins (Oak Ridge National Lab., Tenn.). Nature 188, 249-51(1960) Oct. 15.

Recent literature in radiation bacteriology and allied fields is concerned with the behavior of Escherichia coli B and Escherichia coli B/r. A survey of the literature and experimental experience suggest that the various cultures labeled E. coli B/r are not identical. Preliminary results obtained at ORNL suggested that the viable cell titres and x-ray sensitivities of two B/r cultures being used routinely were not identical. These reported experiments were designed to compare, under standardized conditions, various aspects of B/r cultures obtained from different sources.

Determinations were carried out for snake-formation, penicillin sensitivity, optical density, x-ray sensitivity, and ultraviolet sensitivity. These results support the contention that cultures labeled E. coli B/r form a genotypically and phenotypically heterogeneous group. It is suggested that the designation E. coli B/r be reserved for cultures having all the characteristics originally observed by Witkin. (B.O.G.)

1289

LEUKAEMIA AFTER X-RAY THERAPY. A. D. Vakulenko (Krasnodar Regional Hospital, USSR). Problems Hematol. Blood Transfusion (U.S.S.R.) (English Translation) 5, No. 3, 213-15(1960).

Case histories are presented for three patients who developed leukemia after radiation therapy. The role of previous massive x-ray therapy in the development of leukemia is discussed. (C.H.)

1290

ATTEMPTS TO INCREASE RESISTANCE OF MICE TO BACTERIAL INFECTION BY PROLONGED LOW DOSE γ IRRADIATION. Carolyn W. Hammond, Sonia K. Anderle, and C. Phillip Miller (Univ. of Chicago). Proc. Soc. Exptl. Biol. Med. 105, 1-3(1960) Oct.

CF-1 female mice, which were 4 weeks old were exposed 6 days a week to 0.5, 1, or 2 r γ radiation/day. After 4 to 39 weeks exposure they were intraperitoneally inoculated with graded doses of Pseudomonas aeruginosa. No detectable effect on host resistance to this experimental bacterial infection was demonstrated. (auth)

1291

EFFECT OF X-RADIATION ON UPTAKE OF P^{32} INTO INDIVIDUAL NUCLEOTIDES OF HeLa CELLS. Robert J. Salmon, Leroy C. McLaren, Merle K. Loken, and Donn G. Mosser (Univ. of Minnesota, Minneapolis). Proc. Soc. Exptl. Biol. Med. 105, 15-18(1960) Oct.

Separation of 24 acid soluble phosphorus compounds from irradiated and nonirradiated HeLa cells is described. Relative specific activities of 19 of these compounds are given. Irradiation of the cells produced an increase of relative specific activity and in amount of uridine diphosphoacetylglucosamine and a decrease in amount and specific activity of adenosine triphosphate. (auth)

1292

HEMATOLOGIC RESPONSE OF MONKEYS TO X-IRRADIATION. Samuel Saslaw and Harold N. Carlisle (Ohio State Univ., Columbus). Proc. Soc. Exptl. Biol. Med. 105, 60-2 (1960) Oct.

Total-body x-irradiation of monkeys with 450 r resulted in significant depression of leukocytes as early as the second day with maximal effect noted between 10 to 17 days. Erythrocytes were affected at a later interval with maximum depression at 17 to 19 days post-irradiation. Recovery of leukocytes and erythrocytes to normal levels was observed between 3 to 3½ months. (auth)

1293

SPLEEN ADENOSINE DEAMINASE AND GUANASE ACTIVITIES AFTER WHOLE-BODY X-IRRADIATION OF RATS. Herbert J. Eichel (Hahnemann Medical Coll., Philadelphia). Proc. Soc. Exptl. Biol. Med. 105, 103-7 (1960) Oct.

Adenosine deaminase and guanase activities were studied in homogenates and supernatant fluid fractions, respectively, prepared from spleens of control rats and animals given 600 r of whole-body x irradiation. Specific activities of both enzymes were increased slightly in irradiated animals but total organ activities of both enzymes were decreased as compared to levels obtained in control rats. Interpretation of these and similar findings is discussed, and it is concluded that they do not represent direct or indirect enzyme activation or enzyme synthesis but rather reflect loss of nitrogen content and weight, which are concomitants of splenic involution. (auth)

1294

GONADOTROPIC ANTISERUM EFFECTS IN NORMAL AND IRRADIATED FEMALE MICE. Charles A. Ely (Columbia Univ., New York). Proc. Soc. Exptl. Biol. Med. 105, 111-15(1960) Oct.

Normal and irradiated female mice were given gonadotropic antiserum. Controls received normal rabbit serum, sheep heart antiserum, or normal saline solution. After antihormone serum treatment, ovarian and uterine weights were below those of controls. Ovaries of mice after injection of antihormone serum had fewer corpora lutea than did controls, and interstitial tissue gave evidence of diminished gonadotropic stimulation as indicated by increased frequency of cells indicative of gonadotropic deficiency. Uteri lacking histological evidence of stimulation were found most frequently in animals given antihormone serum. Ovaries and uteri of irradiated animals responded in essentially a similar manner to treatment, but the response was more extreme. Irradiation and gonadotropic antiserum increased gonadotropic potency of pituitary glands; neither normal rabbit serum nor sheep heart antiserum had any effect. A pattern of vaginal cycling was observed after antihormone treatment which was not apparent in cycles of controls. No important differences were found in thymus weight or in adrenal or thyroid histology. (auth)

1295

EFFECTS OF SELECTIVE ULTRAVIOLET IRRADIATION OF CYTOPLASM OF LIVING CELLS. P. O'B. Montgomery and L. L. Hundley (Univ. of Texas, Dallas). Proc. Soc. Exptl. Biol. Med. 105, 117-20(1960) Oct.

Nuclear protection from ultraviolet irradiation during continuous ultraviolet irradiation of cytoplasm confers no degree of protection on cytoplasm or on longevity of the cell. Nuclear protection from ultraviolet irradiation during continuous ultraviolet irradiation of cytoplasm prevents nuclear manifestations of ultraviolet induced nuclear damage. (auth)

1296

RECOVERY FROM RADIATION-INDUCED TOLERANCE TO HOMOLOGOUS TUMOR. Willie W. Smith and Joanne Hollcroft (National Cancer Inst., Bethesda, Md.). Radiation Research 13, 547-55(1960) Oct.

The recovery of transplantation immunity of sublethally irradiated LAF_1 mice to DBA lymphosarcoma P-388 ascites cells was studied under several conditions. The time of recovery was not advanced by isologous bone marrow transplantation but was considerably advanced by transplantation of spleen cells from donors 2 to 3 weeks old. Pretreatment with endotoxin or colchicine produced an advance in granulocyte, and to less extent in lymphocyte recovery, without advancing recovery of the ability to reject the homotransplant. Colchicine treatment, in fact, caused a significant delay in the recovery time. Although the recovery ED_{50} with endotoxin treatment was midway between that of controls and colchicine-treated mice, this difference was too small for significance at a probability of 0.05. (auth)

1297

RADIATION RESPONSE OF MAMMALIAN CELLS GROWN IN CULTURE. I. REPAIR OF X-RAY DAMAGE IN SUR-

VIVING CHINESE HAMSTER CELLS. M. M. Elkind and Harriet Sutton (National Cancer Inst., Bethesda, Md.). Radiation Research 13, 556-93(1960) Oct.

The generally observed threshold type of response of the lethal effect of x rays on cultured mammalian cells means that damage must be accumulated before a lethal response is produced. Surviving cells are, therefore, damaged cells. A study was undertaken, using two-cell lines of the Chinese hamster propagated in vitro, to determine whether or not sublethal damage is heritable, as might be expected if lethal damage is primarily genic. Using 55-kv x rays, glass-attached cells, and colony formation as a criterion of survival, it was found that the cell lines studied displayed mean lethal doses close to those found with other mammalian cell lines (100 to 150 rads). In contrast to other mammalian cell lines, the extrapolation or "hitness" numbers observed were somewhat larger (5 to 10). Surviving cells rapidly repaired their sublethal damage, which appeared to be completed before their first postirradiation division. The system(s) responsible for recovery in surviving cells was not attenuated by repeated exposures. The results are discussed in connection with the question of the primary sites of action of x rays in mammalian cells and the relevance of cellular recovery to radiation therapy. (auth)

1298

A STUDY OF FATIGUE AND MORTALITY IN IRRADIATED RATS. W. Lynn Brown and R. K. White (Univ. of Texas, Austin). Radiation Research 13, 610-16(1960) Oct.

Two groups of Sprague-Dawley rats were trained for 10 days to swim to exhaustion and then irradiated on the eleventh day, with group I being irradiated during a state of exhaustive fatigue and group II irradiated immediately before a period of swimming to exhaustive fatigue. Both groups were also given a second period of swimming 2 hr after termination of the first period. All Ss received 1200 r of Co^{60} at 600 r/min, which is an $LD_{100(10)}$ for the facility used. Group II made a faster recovery from the fatigue of the first swim on the day of irradiation as evidenced by their significantly longer swimming time 2 hr later, but showed a significantly greater mortality rate. Anoxia at the time of irradiation may explain the increased survival of the Ss group I, but it will not account for the difference in recovery from fatigue. (auth)

1299

THE EFFECT OF PROTEUS MORGANII ENDOTOXIN ON RADIATION MORTALITY IN MICE. E. J. Ainsworth and M. H. Hatch (Brown Univ., Providence). Radiation Research 13, 632-8(1960) Oct.

A single 3-μg injection of P. morganii endotoxin decreases radiation mortality in mice. The extent of reduction of mortality and the range in time of effective treatment are functions of the radiation dose to which the animals are exposed. Mortality was reduced at 600 r ($LD_{70(30)}$) if endotoxin was given between 48 hr before and 24 hr after irradiation. The greatest reduction in mortality was observed if endotoxin was given 24 hr before irradiation; under these circumstances mortality was reduced from 71 to 2%. Endotoxin injection after irradiation with 600 r, or at an interval less than 24 hr before irradiation, was less effective than treatment 24 hr before irradiation. As the radiation dose increased to the supralethal levels of 700 and 750 r, a decrease was observed in both the extent of reduction of mortality and the range in time of effective treatment. Endotoxin 24 hr before 800 and 900 r did not decrease mortality, but an increased survival time was observed at 800 r. Endotoxin treatment resulted in an increased resistance to endogenous infection. Endotoxin-treated mice sacrificed at intervals after irradiation with 700 r showed fewer infections than did controls. (auth)

1300

RADIATION EFFECTS AT THE MACROMOLECULAR LEVEL. L. G. Augenstine (U. S. Atomic Energy Commission, Washington, D. C.), J. G. Carter, D. R. Nelson, and H. P. Yockey. Radiation Research, Suppl. 2, 19-48 (1960).

Reaction mechanisms involved in the direct effects of radiation on proteins are discussed. Selected papers are cited to obtain an outline of the properties of those processes whereby energy absorbed in proteins or protein complexes might move from the initial point of absorption to a critical site. In considering the changes induced by radiation which destroy enzymatic activity, evidence is reviewed favoring the hypothesis that a principal effect of radiation is to disrupt a specific and critical portion of the molecule when portions of the absorbed energy become localized there. Preliminary thermoluminescence data are presented to show that electrons displaced by radiation do not become localized at random in biomacromolecules. 50 references. (C.H.)

1301

MODIFYING FACTORS IN THE INACTIVATION OF BIOLOGICAL MACROMOLECULES. Franklin Hutchinson (Yale Univ., New Haven). Radiation Research, Suppl. 2, 49-64(1960).

The effects of modifying factors on the radiation inactivation of biological macromolecules are discussed. A simple model is presented for protein inactivation which makes use only of processes for which there is reasonable physical evidence. A variety of radiation data on enzyme preparations are reviewed. The modifying effects of temperature, oxygen, and molecule size on radiosensitivity are discussed. (C.H.)

1302

PHOTOREACTIVATION. John Jagger (Oak Ridge National Lab., Tenn.). Radiation Research, Suppl. 2, 75-90(1960).

Phenomena involved in the photoreactivation of biological systems damaged by ultraviolet light are discussed. A schematic presentation of the gross characteristics of photoreactivation is included. Mechanisms of radiation damage and protection are postulated. 32 references. (C.H.)

1303

STORAGE, TRANSFER, AND UTILIZATION OF ENERGY FROM X-RAYS IN DRY BACTERIAL SPORES. E. L. Powers, R. B. Webb, and C. F. Ehret (Argonne National Lab., Ill.). Radiation Research, Suppl. 2, 94-121(1960).

Experiments with dry spores of Bacillus megaterium irradiated under various physical conditions show that x rays produce damage in the spores that is not reversed by treatments during or after irradiation. This damage, called in this paper Class I damage, and perhaps the true direct effect of x rays on the sensitive sites of the cell, is independent of temperature changes from 5 to 125°K, but increases from that temperature to about 30°C. Another kind of damage, Class II damage, is not observed unless O_2 or NO is present during the time of irradiation. The effect is about a 25% increase in sensitivity, and is about equivalent for the two gases, suggesting similarity in action between the two. The proposal is made that the quenching action of these gases could account for this effect. A third kind of damage recognized in these studies, and here called Class III damage, is interpreted to be the consequence of the formation of free radicals of long life times. If these react with O_2, either during or after irra-

diation, they are toxic to the cell. If they are removed by heat annealment, or by treatment with radical scavengers such as NO, they are rendered harmless and apparent radiation sensitivity is reduced. Experiments with deuterated spores that have lower radiation sensitivity and with electron spin resonance spectroscopy suggest methods of transport of the energy absorbed, as well as support, in part, the free radical interpretation outlined above. 27 references. (auth)

1304

PROBLEMS OF ENERGY TRANSFER IN RADIATION-INDUCED CHROMOSOME DAMAGE. Sheldon Wolff (Oak Ridge National Lab., Tenn.). Radiation Research, Suppl. 2, 122-32(1960).

The phenomenon of chromosome breakage and its concomitant genetic effects has contributed greatly to our understanding of the biophysical effects of radiation and also of the nature of genetic mechanisms. Nevertheless, the problems of how and where the energy is transferred to the chromosome are largely untouched. The reason for this is that the amounts of energy introduced into the cell exceed by orders of magnitude the amount of energy required to bring about chemical change and the breakage of even the strongest bonds. Any type of chemical bond, therefore, can be broken. A further complication is that, with ionizing radiation, the energy of the photon is not given up in a single encounter but is progressively degraded, thus losing the simplicity of photochemical effects induced by monochromatic ultraviolet where the whole quantum of energy is completely absorbed. Studies have shown that not all of the breakage is induced by the direct breakage of the chromosome by the radiation, and that certain treatments can influence the yield of aberrations. It is in this area that attempts are being made to determine the chemical bonds attacked. Although several models of chromosome structure have been proposed, these all differ from one another and the precise physical or chemical structure of the chromosome is not actually known. Without this information, it is extremely difficult to make any coherent picture of energy transfer and chromosome breakage. 33 references. (auth)

1305

RADIATION EFFECTS IN VIVO: MOLECULAR ASPECTS OF MAMMALIAN RADIOBIOLOGY. Henry Quastler (Brookhaven National Lab., Upton, N. Y.). Radiation Research, Suppl. 2, 627-38(1960).

Data on relative biological effect (RBE) for several mammalian responses were converted into yields per trajectory passing. The relation between this yield and the linear energy transfer (LET) was analyzed using weak assumptions of target theory. The analysis showed that the data presented cannot be fitted with any of the simple models of radiation action: single ionization, effective tail, and unlimited diffusion. The mechanism involved must be of a mixed type. A possible mechanism is proposed. It emphasizes the importance of healing of elementary structures rather than the occurrence of primary damage. (auth)

1306

A DIFFERENCE BETWEEN BIOLOGICAL EFFECTS OF GAMMA RAYS AND HEAVY IONS. Franklin Hutchinson and Stephen S. Easter, Jr. (Yale Univ., New Haven). Science 132, 1311-12(1960) Nov. 4.

When irradiated with γ rays, Artemia eggs show the typical sigmoidal survival curve of a multicellular organism, with little change at low doses and an abrupt decrease in survival above a threshold dose. On irradiation with 160-Mev oxygen ions, the threshold disappears, and viability can be destroyed by passage of a single energetic ion. (auth)

1307

LEUCOCYTIC REACTIONS TO STIMULATION AT VARIOUS INTERVALS AFTER IRRADIATION. L. K. Cherednichenko (State Research Inst. of Industrial Hygiene and Occupational Diseases, Leningrad). Sechenov Physiol. J. (U.S.S.R.) (English Translation) 46, 717-23(1960) Oct.

Defensive adaptation of peripheral white blood, leukocytosis, and leukopenia was studied at various stages in radiation sickness. Three groups comprising 260 grown male rats were used, one as control, one 300-r and one 900-r irradiated. Blood collections were made before and 15, 30, 60, and 120 min after electrical stimulation at 50 volts and 15 ma, 5 times per sec. Leukocytosis was reduced or inverted after stimulation. Leukopenia in response to narcotics developed at all doses and all stages after irradiation. The peripheral blood reaction to stimulation changed in the late stages when there was apparent clinical recovery. (T.R.H.)

1308

THE EVALUATION OF THE BODY IRRADIATION REACTION WITH THE AMOUNT OF ABSORBED RADIATION ENERGY DOSED IN RAD UNITS. E. V. Utekhin (Inst. of Radiation Hygiene, Ministry of Health, USSR). Vestnik Rentgenol. i Radiol. 35, No. 4, 48-50(1960) July-Aug. (In Russian)

By dosing the absorbed energy in volumetric rad units a great advantage could be achieved over the dosage of radiation energy in roentgens. Using rad units to evaluate the degree of the biological reaction referred to the total weight of the irradiated organism (rad/kg) is recommended. In irradiating 2 groups of patients of different weights (in one group it was twice as high as in the other) the dose absorbed in the irradiated volume referred to the unit of body weight increased about 1.5 times, with the total radiation reaction probably increasing in the same proportion. (auth)

1309

RADIATION INJURY IN MAN. Its Chemical and Biological Basis, Pathogenesis and Therapy. Eugene P. Cronkite and Victor P. Bond. Publication Number 382, American Lecture Series. Springfield, Ill., Charles C. Thomas, 1960. 204p. $6.50.

This book is a semitechnical presentation of basic and practical material necessary for understanding the effects of ionizing radiation on man. It is intended for use by practicing physicians, teachers of science in high schools and colleges, students, and technicians who lack special training in radiation physics or radiobiology. The first chapters contain physical, chemical, and basic radiological information, followed by discussions of the physiological and pathological effects of radiation. The acute radiation syndromes and their management and treatment are then discussed. The late and genetic effects of radiation are considered. Possible somatic and genetic effects of low-level exposure, fall-out radiation, and medical uses of x rays and radioisotopes are reviewed. (C.H.)

Radiation Sickness

1310 AD-234421

Yeshiva Univ., New York. Albert Einstein Coll. of Medicine.

RESPONSE OF RADIATED ANIMALS TO ANESTHETICS AND ANALGETICS. Period Covered July 1, 1959–

June 30, 1960. Howard L. Zauder and Louis R. Orkin. Mar. 31, 1960. 14p. Contract DA-49-007-MD-962.

White mice of the Wistar strain were exposed to ionizing radiation utilizing a conventional 250-kv radiotherapy machine. Three dose levels of radiation were chosen; these levels were 350, 450, and 750 r. These correspond to a LD_5, LD_{25}, and LD_{95}, respectively. On the 1st, 2nd, 4th, 7th, 14th, 21st, and 28th day post-radiation the animals were anesthetized. Anesthesia was accomplished with 6% divinyl ether, 6% diethyl ether, 1.5% halothane, 1.8% trichlorethylene, and cyclopropane. The calculated concentration of the latter was 18%. In addition, meperidine, thiopental and pentobarbital were administered. Mortality was significantly increased in the mice who received 350 r after only divinyl ether and thiopental. At the 450 r dose level only cyclopropane failed to increase mortality. At 750 r all agents produced marked increases in the death rate. Decreasing the concentration of the agent decreased the mortality except for divinyl ether. With this agent mortality was significantly increased by concentrations which failed to anesthetize the mice. Increasing the oxygen tension did not decrease the mortality. (auth)

1311 TID-6855

Chicago. Univ.

THE BACTERIOLOGICAL ASPECTS OF RADIATION SICKNESS. C. Phillip Miller. 1959. 18p. Contract AT(11-1)-46. OTS.

Research is briefly reported on changes in susceptibility of mice to bacterial infection during the first three weeks postirradiation, increased resistance to bacterial infection following 75 or 100 r whole-body x irradition, and rapidity of entry of intraperitoneally injected bacteria into the blood stream of normal and irradiated mice. Work done since the beginning of the contract is summarized. (T.R.H.)

1312 JPRS-5649(p.112-21)

OBSERVATION OF A PARATYPHOID EPIZOOTIC IN THE OFFSPRING OF IRRADIATED RATS. O. M. Zemtsova and A. I. Osipovskiĭ (Osipovskiy). Translated from Med. Radiol. 6, No. 6, 47-51(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22780.

1313 JPRS-5649(p.167-71)

BONE MARROW INJECTION IN THE COMPREHENSIVE TREATMENT OF RADIATION SICKNESS COMPLICATED BY SEVERE TRAUMATIC SHOCK. I. V. Il'inskaya and T. N. Astakhova. Translated from Med. Radiol. 6, No. 6, 68(1960).

Intramedullary injection of bone marrow was used in treatment of radiation sickness complicated by severe traumatic shock. Thirty minutes after a 700 r dose, shock was produced in rabbits. Treatment was begun the second day on rabbits brought out of shock. On the third day bone marrow was given intramedullary. A comparison of the hematological studies showed that the bone marrow provided for a more rapid recovery and stabilization of erythropoiesis and leukopoiesis. (T.R.H.)

1314

PROPHYLACTIC STIMULATION OF THROMBOPOIESIS WITH DIPHACIL IN AN ACUTE RADIATION SICKNESS. N. V. Traskunova (Central Research Inst. of Medical Radiology, Ministry of Health, USSR). Med. Radiol. 5, No. 8, 26-9(1960) Aug. (In Russian)

The prevention of the thrombocytopenia development in an acute radiation-sickness was studied. Chronic experiments were carried out on rabbits irradiated with x-ray doses of 600 r. As a thrombopoiesis stimulant, diphacil was introduced during 3 consecutive days prior to irradiation. Peripheral blood and bone marrow were regularly investigated before and after irradiation. Evidence was found that by prophylactic stimulation of thrombopoiesis it is possible to maintain the thrombocyte count in the peripheral blood within the limits of its initial level throughout the course of radiation sickness. Thrombopoiesis stimulation was noted in practically healthy subjects following a single administration of diphacil. A possible use of diphacil in radiation therapy and in a number of affections attended by thrombocytopenia and hemorrhagic syndrome is suggested. (auth)

1315

THE SPECIFIC FEATURES OF REGENERATION PROCESSES OF THE BLOOD IN REMOTE PERIODS FOLLOWING INJURY OF THE ORGANISM WITH Sr^{90} AND X-RAYS. M. S. Lapteva-Popova and I. K. Petrovich. Med. Radiol. 5, No. 8, 80-1(1960) Aug. (In Russian)

Published data indicate a partial or complete normalization period in hematopoiesis of animals exposed to chronic radiation injuries induced by 5 to 15 r of x radiation or by injections of Sr^{90}. However, in some cases acute sickness appears during the restoration period. Studies were made of 41 dogs; 17 dogs were exposed to x radiation and 24 dogs were given Sr^{90} injections. Ten of the 17 exposed to x radiation received 10 r daily and the other seven received 5 r daily. Of the 10 receiving 10 r, three dogs did not exhibit any normalization period. The remaining seven receiving 10 r and the seven receiving 5 r exhibited a definite restoration of the hematopoietic function after 35 to 50 weeks (total doses of 2000 and 1200 r, for the respective groups). Single intravenous injections of 0.1 to 0.2 mc/kg of Sr^{90} resulted in acute radiation sickness with 20% fatality after 1 to 2 months. In the remaining 80%, peripheral blood erythrocytes were restored to the initial number 5 months following the injection. Twenty to thirty-five months later, the erythrocyte number exceeded the initial number by 30 to 40%. (R.V.J.)

1316

THE EFFECT OF IONIZING RADIATION ON THE COURSE OF VACCINAL TULAREMIA AND THE STATE OF THE IMMUNITY IN EXPERIMENT. R. A. Savel'eva. Med. Radiol. 5, No. 8, 82-3(1960) Aug. (In Russian)

Active vaccinal tularemia seriously complicates the course of radiation sickness and results in 100% fatality. The survival of mice proved possible only in the event the acute stages of radiation sickness do not coincide with vaccinal processes. Immunity to 1000 DCLM virus in survived vaccinated irradiated animals was similar to that of nonirradiated vaccinated animals. (R.V.J.)

CHEMISTRY

General and Miscellaneous

1317 CF-60-3-84

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION MONTHLY PROGRESS REPORT FOR CHEMICAL DEVELOPMENT SECTION B, FEBRUARY 1960. R. E. Blanco. May 3, 1960. 37p. OTS.

The initial rate of dissolution of 95.8% ThO_2–$UO_{2.38}$ pellets (consolidated Edison Fuel) in 200% excess of boiling 13M HNO_3 increased from 0 to a maximum of ~13 mg min^{-1} cm^2 as the fluoride concentration in the acid increased from 0 to ~0.7M. The decladding of PWR blanket fuel with the Zirflex Process is being investigated. Ura-

nium and thorium recoveries of >99% were obtained when −10 mesh samples of prototype ungraphitized Pebble Bed Reactor fuel were leached with boiling 13M HNO_3 −0.04M NaF −0.1M $Al(NO_3)_3$. Synthetic Consolidated Edison Fuel, which was processed using an acid-Thorex flowsheet with an acidic feed, was decontaminated from Ru, Zr−Nb, Pa, and rare earths by factors of 20, 2000, 200, and 1000, respectively. In Zirflex scouting tests, Haynes experimental alloy EB4359 corroded at a rate of 6.8 mils/month compared with 8.0 mils/month for vacuum-melted Hastelloy F. Tenth molar $Na_2B_4O_7$ lowered the corrosion rates of Ni−o-nel and Type 309 SCB stainless steel from 27 and 23 mils/month to 13.3 and 10.9 mils/month, respectively, for 24-hr exposures; but the presence of 0.1M dissolved Zircaloy cancelled the inhibiting effect of the borate. In Thorex dissolver solutions the presence of 0.1M $Na_2B_4O_7$ resulted in maximum rates on titanium of 1.0 and 0.3 mils/month for beginning and final solutions, respectively. In Sulfex depassivation cycles starting with 8 and 10M H_2SO_4 and diluting to 4M, Ni-o-nel showed maximum rates of 3.9 and 9.5 mils/month, respectively. Type 304L stainless steel in Darex-Thorex waste solutions continued to corrode at essentially constant maximum rates of about 0.006, 0.030, and 0.065 mils/month, at 50, 65, and 80°C, respectively. Uranyl monobutyl phosphate was prepared in pure form for use in measuring its solubility in aqueous nitric acid and 30% TBP-Amsco-HNO_3 solutions. Calcium silicate reduced ruthenium volatility during the evaporation and calcination of synthetic Purex 1 WW waste containing stable ruthenium, based on a marked reduction of color in the condensate; but in runs with Ru^{106} tracer, only a small reduction in ruthenium volatility was found based on radioactivity in the condensate. More than 1000 volumes of ORNL low-level process water waste, spiked with Cs^{137} and Sr^{85} and adjusted to pH 11.6 were passed through 1 volume of Duolite C-3 sulfonated-phenolic resin without a significant breakthrough of activity. Dowex A-1 chelating resin removed strontium, but not rare earths from a synthetic Purex 1 WW waste to which tartrate was added to prevent iron precipitation on neutralization to pH 5.5. Sulfur determination on unirradiated Dowex 50 resin indicated a sulfonic group capacity of 4.5 meq/dry g and on resin irradiated to almost 12 watt-hrs/dry g a sulfonic group capacity of 3.0 meq/dry g. Studies of the reduction of $CaSO_4$ and of $MgSO_4$ by hydrogen were made using both the pure sulfates and $CaSO_4$ dissolved in molten NaCl and in molten 50% KCl−50% LiCl mixtures. Previous work had shown that $CaSO_4$ was reduced to H_2O and CaS by H_2 and that the reaction proceeded readily in the 800 to 900°C range. Magnesium sulfate is reduced to MgO by H_2 rather than to MgS. (For preceding period see CF-60-2-11.) (W.L.H.)

1318 CF-60-7-108

Oak Ridge National Lab., Tenn.

CHEMICAL TECHNOLOGY DIVISION, CHEMICAL DEVELOPMENT SECTION C PROGRESS REPORT FOR JUNE−JULY 1960. K. B. Brown. Sept. 26, 1960. 60p. OTS.

The recovery of thorium from Blind River Mill liquor by extraction with two primary amines is described. Continuous countercurrent testing of the process for recovery of technetium, neptunium, and uranium by tertiary amine extraction from fluorination plant UF_6 transfer cylinder wash solutions in a laboratory-scale mixer-settler system showed good recoveries with relatively high mutual separations from both simulated and actual plant feeds. Results of tests show that di(2-ethylhexyl) phosphoric acid (D2EHPA) in hydrocarbon solution extracts Pu(IV) from dilute HNO_3 solutions much more strongly than do amines or phosphine oxide. In a study of relative extractabilities of americium and lanthanons from aqueous solutions by several reagents, the only preferential extractions of americium over the fission-product rare earths were with phosphate (TBP) and phosphonate esters from concentrated lithium chloride solutions. The other reagents tested were a primary amine, a tertiary amine, a quaternary ammonium compound, and a monoalkylphosphoric acid. Sec-butyl benzene, dibutyl carbitol, n-butyl ether, and di-isobutyl ketone were examined as diluents for certain extraction reagents of potential use in radiochemical processing. The solubility of di-sec-butyl phenylphosphonate and tributylphosphate complexes of uranyl and thorium nitrates in sec-butylbenzene was investigated. (For preceding period see CF-60-5-114.) (W.L.H.)

1319 TID-6367

California Research Corp., San Francisco.

PETROLEUM REFINERY STREAMS AS PROSPECTIVE REACTOR COOLANTS: THERMAL STABILITY INVESTIGATIONS. J. G. Carroll. May 31, 1960. 50p. Contract AT(11-1)-174. OTS.

Thermal stability tests were conducted for 48 hrs at 750°F on 140 typical materials from petroleum refinery streams. The most stable fluids were light cycle oils and bottoms from catalytic reforming operations. The most important factor affecting stability was the degree of refinement. Fluids considered for coolant uses showed a thermal stability at 750°F comparable to that of polyphenyls at about 900°F. Data and discussion of methods and results are included. (J.R.D.)

1320 TID-6437

Kansas State Univ., Manhattan.

THE ANALYSIS OF SOME VOLATILE PHOSPHORUS COMPOUNDS BY GAS-LIQUID CHROMATOGRAPHY. Saul Howard Shipotofsky. 1960. Includes Papers: GAS CHROMATOGRAPHIC ANALYSIS OF SOME VOLATILE PHOSPHORUS COMPOUNDS. S[aul] H[oward] Shipotofsky and H. C. Moser. REACTIONS OF TRITIUM ATOMS WITH FROZEN HYDROCARBONS. R. D. Shores and H. C. Moser. 22p. Contract AT(11-1)-584. OTS.

In the first paper, a gas chromatographic method for the analysis of mixtures of $(CH_3O)_2POH-(C_2H_5O)_2POH$, PCl_3-PSCl_3, and PCl_3-POCl_3 was developed. Pyrex glass was used as the column and body of the thermal conductivity cell, and tantalum wire was employed for the sensing elements. In the second paper, tritium atoms generated from molecular hydrogen at a tungsten filament at 1750°C were reacted with the following frozen compounds: benzene, cyclohexane, cyclohexene, 1−hexene, and n−hexane. Both addition and substitution were observed with unsaturated compounds. With saturated compounds, substitution was the principle reaction that occurred. (C.J.G.)

1321 TID-6652

Rensselaer Polytechnic Inst., Troy, N. Y.

THERMODYNAMICS AND CONDUCTANCE OF SIMPLE ELECTROLYTES IN POLAR ORGANIC SOLVENTS. Progress Report No. 4 [for period] February 1, 1960−September 30, 1960 and Proposal for Renewal of Contract. George J. Janz. Oct. 1960. 11p. Contract AT(30-1)-1993. OTS.

The progress of the investigations on the thermodynamics and electrical conductance of simple electrolytes in polar organic solvents is assessed, and a forecast of the research is made. The emf data for HCl in ethanol is being used to evaluate the various empirical, semiempirical, and theoretical extrapolation methods for calculation of the standard potential and activities of the solute species. The investi-

gations of ionic interactions in organic solvent media by electrical conductance were extended to the salts $AgNO_3$, KI, and CoX_2 (where X = Cl, Br, or I). The region of highly concentrated solutions is being studied by the CH_3CN-$AgNO_3$ system, the behavior of a 1:1 electrolyte in extreme dilution is being studied by the CH_3CN-KI system, and the specific interactions of solvent-solutes and solvent-ions are being studied by the CH_3CN-CoX_2 systems. Spectrophotometry is being used, as required, to gain additional insight on these solutions. (auth)

1322 UCRL-9350

California. Univ., Berkeley. Lawrence Radiation Lab. SOME PROBLEMS OF CRYSTALLOGRAPHY (thesis). Quintin C. Johnson. Aug. 1960. 59p. Contract W-7405-eng-48. OTS.

Calculations of minimum-energy structures were made in an effort to ascertain the effectiveness of the Born expression for the energy of a crystal. This expression assumes an r^{-1} attractive potential due to charge separation and an r^{-n} repulsive force due to the Pauli effect. Application of this model to a number of problems of crystal chemistry indicates that ionic substances may be suitably described by the above potential. This is shown by a comparison of the minimum-energy-structures of LaOCl, YOCl, $SrBr_2$, brookite, and YF_3, to the actual structures. Consideration of the $CdCl_2$ structure shows that van der Waals forces can not always be neglected. The structure of semicarbazide hydrochloride ($H_2NHNCONH_2 \cdot HCl$) was also determined by single-crystal x-ray-diffraction methods. The space group is $P2_12_12_1$ and the cell dimensions are a = 7.54 ± 0.02 A, b = 13.22 ± 0.03 A, and c = 4.67 ± 0.02 A. The nitrogen-nitrogen single-bond distance is 1.457 ± 0.007 A. In order to determine a fairly reliable carbon-nitrogen bond distance in a quaternary amine, a redetermination of the structure of tetramethylammonium bromide ($(CH_3)_4NBr$) was carried out by single crystal x-ray-diffraction methods. The results are in close agreement with work done by previous researchers. The carbon-nitrogen bond distance is equal to 1.50 ± 0.02 A. Attempts to localize the hydrogen atoms were unsuccessful. (auth)

1323 AEC-tr-4275

Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoĭ Energii.

DETERMINATION OF THE COMPOSITION AND INSTABILITY CONSTANTS OF OXALATE, NITRATE AND SULFATE COMPLEXES OF Am(III) AND Cm(III) BY ION EXCHANGE. I. A. Lebedev, S. V. Pirozhkov, and G. N. Yakovlev. Translated by Robert A. Penneman and Helen J. Chick (Los Alamos Scientific Lab.). 21p. JCL or LC.

The effects of various factors on the sorption of Am^{+3} and Cm^{+3} from oxalate, nitrate, and sulfate solutions onto KU-2 cation-exchange resin were studied. The formation of Am^{+3} and Cm^{+3} complexes with oxalate, nitrate, and sulfate ions was studied by ion-exchange methods. The composition and instability constants of these compounds were determined. (C.J.G.)

1324 JPRS-5431

THE RELATIONSHIP OF THE ISOTOPE EXCHANGE OF HYDROGEN AND OXYGEN IN SOLUTIONS TO MOLECULAR STRUCTURES. (Zavisimost Isotopnogo Obmena Vodoroda i Kisloroda v Rastvorakh ot Stroyeniya Molekyl.) Translated from Voprosy Khim. Kinetiki, Kataliza, i Reaktsionnoĭ Sposobnosti, Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, 18-23(1955). 10p. OTS.

Investigations concerned with the neutral effects of molecules on one another in solutions were conducted. Hydrogen exchange in various compounds is discussed, and it is noted that rapid hydrogen exchange in dissolved compounds is usually attributed to their electrolytic dissociation; whereas in slow exchange the velocity is influenced by the presence of suitable substitutes, acidity, and the location of bond junctions. Oxygen exchange proceeds slowly and depends on the pH of the medium. The data indicate that oxygen exchange is greatly influenced also by the structure of electron shells in the molecules. (J.R.D)

1325

THE ION EXCHANGE PROPERTIES OF SILICA GEL. I. THE SORPTION OF Na^+, Ca^{2+}, Ba^{2+}, UO_2^{2+}, Gd^{3+}, Zr(IV) + Nb, U(IV) AND Pu(IV). Sten Ahrland, Ingmar Grenthe, and Bertil Norén (Univ. of Lund, Sweden). Acta Chem. Scand. 14, 1059-76(1960). (In English)

The metal ion sorption on silica gel was investigated. The silica gel acts in this respect as an ion exchanger of the weakly acid type and in the case of a monovalent cation the exchange reaction can be written as $Si-OH + Me^+ \rightleftharpoons Si-OMe + H^+$. For this equilibrium the law of mass action seems to be valid. Moreover an amount of hydrogen ions equivalent to the amount of metal ions sorbed is set free at the sorption on silica gel that is saturated with hydrogen ions. The amount of metal ion sorbed depends strongly on the pH of the solution. At the sorption of strongly hydrolyzed (presumably high molecular) ions the equilibrium is reached slowly, whereas the sorption of nonhydrolyzed (low molecular) ions is quite rapid, the equilibrium usually being reached within five minutes. (auth)

1326

THE REACTIONS OF HYDROGEN ATOMS WITH SOME ORGANIC LIQUIDS. R. B. Ingalls and J. R. Hardy (Atomics International, Canoga Park, Calif.). Can. J. Chem. 38, 1734-41(1960) Oct.

Measurements were made of isotopic exchange and deuterium pressure change during deuterium atom bombardment of o-terphenyl, toluene, and eicosane just above their melting points. The number of molecules of HD formed was larger than the number of molecules lost or gained by the gas phase. A mechanism of reaction of deuterium atoms with aromatic liquids is proposed. (auth)

1327

RADIOACTIVE ATOMS DISTRIBUTION IN AROMATIC COMPOUNDS LABELLED BY EXPOSURE TO TRITIUM GAS. Fulvio Cacace, Angelo Guarino, Gabriella Montefinale, and Elvira Possagno (Università, Rome). Intern. J. Appl. Radiation and Isotopes 8, 82-9(1960) July. (In English)

Distribution of tritium atoms in chlorobenzene, nitrobenzene, and anisole, labeled by contact with H^3 gas, was determined. In all the substances examined, ortho and para positions account for about $^2/_3$ of the radioactivity of the pure tritiated compound. The ratio of activity found in para and meta positions, ranges from 1:1 in the chlorobenzene to 1:0.6 in the anisole and 1:4 in the nitrobenzene, depending on the nature of the substituent groups in the irradiated compound. (auth)

1328

THREE-BODY RECOMBINATION OF OXYGEN ATOMS. Ernest Bauer (Ford Motor Co., Newport Beach, Calif.) and Morris Salkoff (Institut Blaise Pascal, Paris). J. Chem. Phys. 33, 1202-8(1960) Oct.

A quantum mechanical perturbed stationary state calculation was made of the rate of three-body recombination of oxygen atoms in the presence of an oxygen molecule as third body. The recombination is considered to take place in highly vibrationally excited states (v = 9, 10) of the

A $^3\Sigma_u^+$ state of O_2. There are no adjustable parameters in the calculation. For the interaction potential, the results obtained in a previous calculation, which were obtained by comparison with experimental measurements of vibrational relaxation times in oxygen, were used. At temperatures of the order 300 to 3000°K, the calculated recombination coefficient in these two states is of the order 1 to 10×10^{-33} cm^6/sec, and agrees to within better than a factor of three with recent experimental measurements. (auth)

1329

DIPOLE MOMENTS AND STRUCTURES OF SOME BIS-(TRIFLUOROACETYLACETONATO) COMPLEXES. R. H. Holm and F. A. Cotton (Massachusetts Inst. of Tech., Cambridge). J. Inorg. & Nuclear Chem. 15, 63-6(1960) Sept. (In English)

The dipole moments, in benzene solution, of bis-(trifluoroacetylacetonato)-Be(II), Co(II), and Cu(II) were measured. The results are believed to indicate that, under the conditions of the measurements, the latter two exist as planar complexes with a cis-trans ratio of about 3 : 2. This is the same conclusion previously reached by McCarthy and Martell by an independent method for the Cu(II) compound alone. (auth)

1330

COMPOSITION AND STABILITY OF SOME METAL-5-SULPHOSALICYLATE COMPLEXES. C. V. Banks and R. S. Singh (Ames Lab., Ames, Iowa). J. Inorg. & Nuclear Chem. 15, 125-32(1960) Sept. (In English)

The 5-sulfosalicylate complexes of Al(III), Cr(III), U(VI), Ni(II), Co(II), and Mn(II) were investigated by the potentiometric method. The Al(III)- and U(VI)-5-sulfosalicylate systems were investigated spectrophotometrically. It was found that Al(III) forms 1 : 1, 1 : 2, and 1 : 3 complexes at pH values of 3.8, 5.5, and 8.5, respectively, and that U(VI) forms 1 : 1 and 1 : 2 complexes at pH values of 4.5 and 7.5, respectively. The stability constants for Be(II)- and Cu(II)-5-sulfosalicylate complexes were recalculated. The log k values found by the potentiometric method for the step-wise stability constants are as follows: Al, 13.20, 9.63, 6.06; Cr, 9.56; U, 11.14, 8.06; Ni, 6.42, 3.82; Co, 6.13, 3.69; Mn, 5.24, 3.00; Be, 11.71, 9.10; and Cu, 9.52, 6.93. (auth)

1331

HARMONIC WAVE NUMBERS, ROTATIONAL DISTORTION CONSTANTS, AND THERMODYNAMIC PROPERTIES FOR PARTIALLY DEUTERATED AND TRITIATED MOLECULES OF THE TYPE XYZ_2 (X = N, P, or As; Y, Z = H, D, or T). G. Thyagarajan, S. Sundaram, and Forrest F. Cleveland (Illinois Inst. of Tech., Chicago). J. Mol. Spectroscopy 5, 307-18(1960) Oct. (In English)

With the use of a harmonic potential energy function, the harmonic wave numbers for partially deuterated and tritiated molecules of the type XYZ_2 (X = N, P, or As; Y, Z = H, D, or T) were calculated by the Wilson FG matrix method. The rotational distortion constants for all these molecules were calculated on the basis of the first-order perturbation theory of Kivelson and Wilson. With the calculated wave numbers, the molar thermodynamic properties were obtained for 12 temperatures between 100 and 1000°K for the ideal gaseous state at one atmosphere pressure and for a rigid-rotor harmonic-oscillator approximation. (auth)

1332

THORIUM TARTRATE COMPLEXES BY POLARIMETRY. Leonard I. Katzin and Elsie Gulyas (Argonne National Lab., Ill.). J. Phys. Chem. 64, 1347-50(1960) Oct.

It is shown that optical rotation changes can be used to follow the formation of complexes between tartrate and Th(IV). The greatest rotation change in acid solutions was given by a species with one tartrate per thorium, found at pH 3 to 3.5. Two tartrates per thorium on the average were required throughout the whole pH range to keep the thorium in solution. In the region of pH 3, resin column experiments indicated that the dominant complexes are neutral. Increases of pH introduced increasing proportions of negatively charged complex, probably basic. More alkaline solutions showed marked slow changes of rotation, accompanied by changes of pH, which indicated probable release of H^+ by tartrate hydroxyl groups, which does not occur in alkaline tartrate solutions without thorium. (auth)

1333

ABSORPTION SPECTRA OF NITRO COMPOUNDS. FURTHER SOLVENT PERTURBATIONS. H. E. Ungnade, E. D. Loughran, and L. W. Kissinger (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 64, 1410-15(1960) Oct.

Intensity measurements were made in the 280 mμ region for nitromethane and 2,2-dinitropropane in primary, secondary, and tertiary amines and other solvents. The observed intensity increases are believed to be due to an electron donor-acceptor interaction between solvent and solute. The magnitude of the effects in nitrogen-containing solvents parallels the basic strengths that would be predicted from inductive effects alone. (auth)

1334

INFRARED AND ULTRAVIOLET ABSORPTION SPECTRA OF SOME SALTS AND METAL CHELATES OF ANTHRANILIC ACID. Ann Gertrude Hill and Columba Curran (Univ. of Notre Dame, Ind.). J. Phys. Chem. 64, 1519-22 (1960) Oct.

Absorption maxima in the 3000 and 1550 cm^{-1} regions in potassium bromide disks, in the 300 mμ region in potassium bromide disks, and in ethanol solutions are reported for anthranilic acid; its sodium, potassium, calcium, strontium, and barium salts; and its chelates with magnesium, zinc, cadmium, nickel, and copper. Chelation shifts the 320 mμ band of the anthranilate ion to shorter wave lengths, decreases the frequencies of the N–H stretching vibrations, causes an inversion of the relative intensities of the 1615 and 1580 cm^{-1} peaks and effects small shifts to higher frequencies of the band attributed to the antisymmetric COO^- stretching vibration. The spectra indicates a trans planar square configuration for all complexes. The chelates are appreciably dissociated in ethanol. (auth)

1335

THE HEAT CAPACITY AND THERMODYNAMIC PROPERTIES OF SODIUM FORMATE FROM 5 TO 350°K. Edgar F. Westrum, Jr., Shu-Sing Chang, and Norman E. Levitin (Univ. of Michigan, Ann Arbor). J. Phys. Chem. 64, 1553-4 (1960) Oct.

The heat capacity of anhydrous sodium formate was determined at low temperatures by adiabatic calorimetry and found to be normal. Thermodynamic functions were evaluated from these data. The heat capacity at constant pressure, entropy, enthalpy increment $(H^0 - H_0^0)$, and free energy function $[(F^0 - H_0^0)/T]$ at 298.15°K are 19.76 ± 0.01 cal/(deg mole), 24.80 cal/(deg mole), 3766.9 cal/mole, and −12.16 cal/(deg mole), respectively. (auth)

1336

EXPLANATION OF THE MECHANISM OF FATTY ACID OXIDATION USING O^{18}. H. Hübner (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 839-43(1960) Sept. (In German)

Fatty acids are attacked by oxygen at higher temperatures (100 to 130°C). An oxidized fatty acid was analyzed

by means of the gas chromatographic method. The results show that the fatty acid molecule undergoes a reaction with oxygen in α-position from the carboxylic group. It could be established furthermore by labeling the carboxylic group with the isotope O^{18} that the separated carbon dioxide derived from the carboxylic group of the originally applicated fatty acid. (auth)

1337

BASES OF STATISTICAL THERMODYNAMICS OF ISOTOPE SYSTEMS WITH CHEMICAL SYSTEMS. G. Vojta (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 917-27(1960) Sept. (In German)

An elementary representation of the methods and results of statistical thermodynamics of chemical isotope systems is given. A brief account of the possibilities of statistical thermodynamics is followed by a short discussion of procedures for the determination of vibrational frequencies of isotopic molecules. A survey of partition function ratios and differences of thermodynamic functions of isotopic molecules is presented. A treatment is given of methods for the determination of chemical isotopic exchange equilibria in ideal gases and in real homogeneous and heterogeneous systems. A discussion of problems in chemical kinetics is given. (auth)

1338

APPROXIMATION FORMULAS FOR QUANTUM STATISTICAL CALCULATIONS OF CHEMICAL ISOTOPE EXCHANGE EQUILIBRIA AND APPLICATION TO MOLECULES WITH O^{18}. G. Vojta (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 927-30(1960) Sept. (In German)

The relation of Bigeleisen and Mayer for reduced partition ratios of isotopic molecules is rewritten and extended, giving the possibility of prompt and more exact statistical calculations with common tables of functions. For a number of molecules of the types XY_4 (tetrad) and XY_3 (pyramid), with $Y = O^{16}$ and O^{18} partition function, ratios are calculated in two approximations and exactly for 273.15°K and 300°K. The accuracy of another approximative formula of Bigeleisen is practically sufficient for the treated molecules. From the partition function ratios result the equilibrium is constant for all possible exchange reactions between these molecules. (auth)

1339

ENERGY MIGRATION IN AGGREGATED PIGMENT SYSTEMS AND BIOLOGICAL ENERGY CONVERSION. Gordon Tollin (Univ. of California, Berkeley). Radiation Research, Suppl. 2, 387-406(1960).

Theoretical aspects of energy migration in aggregated pigments are reviewed. Some of the possible implications for biology, particularly for photosynthetic systems, are considered. Topics discussed include reaction mechanisms involved in energy migration by exciton transfer, which involve the migration of electromagnetic energy throughout the aggregate; and charge-carrier migration, which involves the motion of free electrons and/or free positive holes. These properties of pure materials are used as models for biological systems. Results are reported from studies of the primary quantum-conversion process in photosynthesis, and model systems related to the naturally occurring system are described. Experimental results are reported which are consistent with an hypothesis involving the formation of charge carriers by illumination of chlorophyll, the trapping of these carriers, and their utilization in chemical enzymatic reactions. The effects of a number of substances on the conductive properties of pigments were investigated. A schematic diagram is presented of sample cells used in the conductivity measurements. Systems for which results are reported include metal-free phthalocyanine, tetracene, coronene, decacyclene, and methyl pheophorbide as the semiconductor, or electron donor, moiety, and chloranil, ortho-chloranil, and phenanthrenequinone as the oxidizing, or electron acceptor, moiety. A schematic diagram is presented of hypothetical photosynthetic quantum-conversion processes. Such a scheme would provide a mechanism for the formation of oxidizing and reducing entities for light energy, for their utilization in photosynthesis, and for the prevention of their recombination. It would also be consistent with results with plant materials and similar processes in model systems. 54 references. (C.H.)

1340

ELECTRICAL PROPERTIES OF ORGANIC SOLIDS. David Kearns (Univ. of California, Berkeley). Radiation Research, Suppl. 2, 407-31(1960).

Considerations are presented which indicate that the over-all result of adding a strong electron acceptor to a phthalocyanine film is to increase the quantum yield for charge-carrier production and to increase charge-carrier life-time. Thus, the ortho-chloranil negative ions act as efficient centers for the conversion of electromagnetic energy (which may be absorbed by phthalocyanine molecules situated many molecular diameters away) into charge carriers, and also act as effective electron traps. Similar, but apparently less effective, impurity centers existing in small amounts in undoped phthalocyanine could be responsible for its photoconductivity. Alternatively, the host molecules themselves could function as ionization centers. With pentacene and tetracene, it appears that the observed photo- and semiconductivity of the pure substances is largely due to the presence of impurity electron acceptors. Oxygen was not excluded during the measurements and could conceivably be the impurity electron acceptor. The effect of adding a strong reducing agent (electron donor) is to ionize these impurity acceptors, to prevent them from receiving electrons from the host molecule, and consequently to diminish both dark- and photo-conductivity. The present results indicate that the presence of electron-accepting impurities in organic semiconducting systems will increase the probability of utilization of charge carriers for chemical or biological processes by making recombination less probable and by increasing quantum yields. These factors would tend to counteract the effect of low-carrier mobilities. This may have significance for photosynthesis in plant materials, in which the efficiency of utilization of electromagnetic energy for chemical processes is high. 29 references. (C.H.)

Analytical Procedures

1341 AERE-AM-62

United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Chatham Outstation, Kent, England.

THE DETERMINATION OF RARE EARTHS IN URANIUM DIOXIDE. D. L. G. Smith and K. E. Smith. July 1960. 24p. BIS.

The rare earths together with other impurities are separated from the sample chromatographically on a cellulose column. After the cellulose is ashed, the rare earths are concentrated by coprecipitation with calcium as oxalate and finally with iron as hydroxide and are determined spectrographically by a modification of an iron flux method. (AERE-AM-46.) (auth)

1342 DP-503

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

PRECISE DETERMINATION OF URANIUM IN URANYL NITRATE–ALUMINUM NITRATE SOLUTIONS. Constance M. MacDonald. July 1960. 8p. Contract AT(07-2)-1. OTS.

A method was developed for the determination of uranium in aqueous solutions that contain aluminum and in tributyl phosphate. Uranium was separated from aluminum by an ion exchange technique and was then determined gravimetrically by the 8-hydroxyquinoline method. The coefficient of variation was 0.3%. (auth)

1343 NP-9166(p.257-61)

India. Atomic Energy Establishment, Trombay.

A PHOTO NEUTRON METHOD FOR THE ESTIMATION OF DEUTERIUM CONCENTRATION IN WATER. V. A. Gokhale, M. P. Navalkar, M. Srinivasan, and K. R. Subbaramu.

Photodisintegration of deuterons was investigated as a method for determining the deuterium concentration in water, using γ rays from $Na^{24}Cl$ and BF_3 counters to detect photoneutrons. The sample, $Na^{24}Cl$, and BF_3 counters were contained in a graphite moderator assembly, and the background was 14 to 20 cpm. The possible sources of error were studied; the largest one was found to be statistical. Two water samples containing 13.3 and 3.3% more deuterium than ordinary water were compared with ordinary water using the above method; the ratio of the sample counting rate to that of ordinary water was found to be 1.127 ± 0.04 and 1.057 ± 0.04, respectively. In the ordinary water concentration ranges, the heavy water content can be determined with an accuracy of < 4%; thus this method compares favorably with mass spectrometric methods. The advantage of this method is that no sample purification or time-consuming processes are required. (D.L.C.)

1344 NP-9366

Argentina. Comisión Nacional de Energía Atómica, Buenos Aires.

DETERMINACIÓN DE MICROCANTIDADES DE URANIO EN EL CONTROL DE PROCESOS DE EXTRACCIÓN LIQUIDO–LIQUIDO (DAPEX). Informe No. 37. (Determination of Microquantities of Uranium in the Control of Liquid-Liquid Extraction Processes (Dapex)). Report No. 37. Jorge A. Blay. 1960. 16p.

The problem of the determination of micro-amounts of uranium in aqueous and organic phases in liquid-liquid extraction processes, original ores, and extraction residues was solved by a chromatographic separation of the uranium by means of columns of activated cellulose and further spectrophotometric evaluation using the thiocyanate complex in aqueous medium. The usable range is 5 to 200 μg.

1345 CEA-tr-R-939

UTILISATION DE LA MÉTHODE RADIOMÉTRIQUE POUR LE DOSAGE DE L'URANIUM, DU THORIUM ET DU RADIUM DANS LES MINERAIS. (Use of a Radiometric Method for Determination of Uranium, Thorium, and Radium in Ores). E. I. Zheleznova and D. V. Tokareva. Translated into French by B. de Trezvinsky from Zavodskaya Lab. 24, 959-63(1958). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 10927.

1346 CEA-tr-R-947

DOSAGE SPECTROGRAPHIQUE DU HAFNIUM DANS LE BIOXYDE DE ZIRCONIUM. (Spectrographic Determination of Hafnium in Zirconium Dioxide). G. I. Kibisov (Kibissov). Translated into French from Zhur. Anal. Khim. 13, 653-6 (1958). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 7535.

1347 CEA-tr-R-956

LA CHIMIE ANALYTIQUE DU HAFNIUM. (Analytical Chemistry of Hafnium). L. N. Komissarova and V. E. Plyushchev (Pliushev). Translated into French from Zhur. Anal. Khim. 13, 709-15(1958). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 7538.

1348

A NEW SENSITIVE REAGENT FOR URANIUM. 1-2 (THIAZOLYLAZO)-m-DIMETHYLAMINOPHENOL (TAM). APPLICATION TO THE ASSAY OF ROCKS AND SOLUTIONS LOW IN URANIUM. Emil Sørensen (Danish Atomic Energy Commission, Research Establishment, Risö). Acta Chem. Scand. 14, 965-8(1960). (In English)

An analytical method for uranium is presented. It is based on the extraction of uranyl nitrate with methyl isobutyl ketone from a sample solution saturated with aluminum nitrate. An intensely colored complex is formed in situ by addition of the reagent 1-(2-thiazolylazo)-m-dimethylaminophenol. The uranium content can be determined spectrophotometrically with a sensitivity of about 0.1 μg. (auth)

1349

ION COUNTING AND ACCUMULATION SYSTEM FOR MASS SPECTROMETRY OF VERY SMALL SAMPLES. APPLICATION TO URANIUM AND PLUTONIUM. G. W. Barton, Jr., L. E. Gibson, and L. F. Tolman (Univ. of California, Livermore). Anal. Chem. 32, 1599-1601(1960) Nov.

A system was devised which permits rapid and precise isotopic analysis of 10^{-8}-g samples of uranium and plutonium, and of other elements and compounds for which beams of 10^{-18} to 10^{-12} amp can be achieved and kept for several minutes. The system is insensitive to growth or decay of sample emission by factors of 2 or more in a 1-min period. The ion beam is detected by an electron multiplier, and individual ion pulses are accumulated in a modified 256-channel pulse analyzer. The spectrum is scanned by sweeping the accelerating voltage in synchronism with a scan of the analyzer channels so that pulses in each mass increment are assigned a corresponding channel. The normal sweep rate is 8 complete spectra per second, which are accumulated in two groups, the up-mass sweep and the down-mass sweep. The data stored in the analyzer at the end of a run are printed out in decimal form on a five-line-per-second printer. Reduction of the data consists only of correcting for background and coincidence loss and normalizing to a convenient parameter. (auth)

1350

DETERMINATION OF RADIOACTIVE ZIRCONIUM IN FISSIONED PLUTONIUM. Jesse W. T. Meadows and George M. Matlack (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 32, 1607-10(1960) Nov.

Radioisotopes of zirconium, formed in the fission of plutonium, are determined by multiple precipitations of zirconium p-bromomandelate. Tellurium, the only interfering fission product, is removed by precipitation of carrier tellurium with sulfur dioxide. This serves to reduce plutonium(IV) to plutonium(III), which is not precipitated by p-bromomandelic acid. Four determinations may be made in 5 hr with a coefficient of variation of 2%. (auth)

1351

DETERMINATION OF OXYGEN IN YTTRIUM AND

YTTRIUM FLUORIDE BY THE INERT GAS FUSION METHOD. Charles V. Banks, Jerome W. O'Laughlin, and George J. Kamin (Ames Lab., Ames, Iowa). Anal Chem. 32, 1613-16(1960) Nov.

The inert gas-fusion technique was applied to the determination of oxygen in yttrium metal and yttrium fluoride. The problem arising from the interaction of the fluoride with the glass apparatus was solved by the addition of a magnesium oxide reagent in the train. The method was shown to be simple, rapid, and precise. The results on yttrium metal were checked with the vacuum fusion and emission spectroscopic techniques; the results on yttrium fluoride were checked with the vacuum distillation and $KBrF_4$ techniques. (auth)

1352

DETERMINATION OF OXYGEN IN BERYLLIUM METAL BY THE INERT GAS FUSION METHOD. Silve Kallmann and Fred Collier (Ledoux and Co., Teaneck, N. J.). Anal. Chem. 32, 1616-19(1960) Nov.

In an inert gas-fusion procedure, beryllium oxide is made to react with carbon in a graphite crucible yielding carbon monoxide which, after oxidation to carbon dioxide, is measured conductometrically. The work was carried out with a Leco inert gas-fusion apparatus which is slightly modified to accommodate larger sample weights. To provide an intimate contact of the molten sample with the graphite and to minimize the evaporation of beryllium, with the danger of subsequent gettering, nickel is used as a flux. The method is rapid and simple enough to permit the use of untrained personnel. (auth)

1353

X-RAY SPECTROGRAPHIC DETERMINATION OF ZIRCONIUM, TUNGSTEN, VANADIUM, IRON, TITANIUM, TANTALUM, AND NIOBIUM OXIDES. APPLICATION OF THE CORRECTION FACTOR METHOD. Betty J. Mitchell (Union Carbide Metals Co., Niagara Falls, N. Y.). Anal. Chem. 32, 1652-6(1960) Nov.

A multichannel x-ray spectrograph was applied to the determination of the combined oxides of zirconium, tungsten, vanadium, iron, titanium, tantalum, and niobium. Simultaneous measurement of combinations of from two to seven elements varying in concentration range from 0.1 to 99.9% requires less than 2 min; total x-ray analytical time averages less than 15 min per oxide sample. An instrumental precision of better than ±0.5% of the quantity being measured is possible for high-percentage components. The effects of interelement absorption are corrected by an arithmetic factor method. (auth)

1354

SPECTROPHOTOMETRIC DETERMINATION OF THORIUM WITH ERIOCHROME BLACK T. (ETHYLENEDINITRILO) TETRAACETIC ACID AND 2,2',2"-NITRILOTRIETHANOL AS MASKING AGENTS. Peter F. Lott, K. L. Cheng, and Bennet C. H. Kwan (Univ. of Missouri, Rolla). Anal. Chem. 32, 1702-4(1960) Nov.

A new highly selective spectrophotometric method for the determination of thorium is based on the colored complex formed with thorium and Eriochrome Black T. The dye complex has a molar absorptivity of 35,000; the reaction shows a sensitivity of 0.004 μg of thorium per cm^2 per 0.001 absorption unit at 700 mμ. The procedure is free from the interference of most cations, particularly the rare earths. Masking agents prevent foreign ions from reacting with the dye. Thorium can be determined in the presence of the alkali metals, alkaline earths, most transition metals, the rare earths, and heavy metals like bismuth. Iron interferes most and the removal of its interference is discussed. (auth)

1355

X-RAY SPECTROMETRIC FLUORESCENCE. I. APPLICATION TO THE DETERMINATION OF THORIUM IN MINERALS. J. Bermúdez Polonio, F. de la Cruz Castillo, and R. Fernández Cellini (Junta de Energia Nuclear, Madrid). Anales real soc. espãn. fís. y quím. (Madrid), Ser. B 56, 569-78(1960) June. (In Spanish)

An x-ray spectrometric method was developed for analysis of thorium in ores in the range of concentration from 0.01 to 0.5% ThO_2, using selenium as an internal standard. The concentration of thorium is determined in a working curve prepared by plotting the percentage of ThO_2 against the ratio intensity of the ThL_{α_1} line to SeK_{β_1} line. The method makes use of a Geiger counter together with associated electronic equipment for the measurement of intensities of x-ray emission lines. Tests were made to obtain preliminary information about the accuracy attainable by several instrumental factors. In addition, the statistics of x-ray emission process were checked in order to determine how experimental data are in agreement with theory. The standard deviation is 3.5 and 2% for a content of 0.05 and 0.4% of ThO_2, respectively. (auth)

1356

X-RAY SPECTROMETRIC FLUORESCENCE. II. APPLICATION TO THE DETERMINATION OF URANIUM IN MINERALS. J. Bermúdez Polonio, F. de la Cruz Castillo, and R. Fernández Cellini (Junta de Energia Nuclear, Madrid). Anales real soc. espãn. fís. y quím. (Madrid), Ser. B 56, 579-88(1960) June. (In Spanish)

A method of analysis of uranium in ores by x-ray spectrometry was developed, using the internal standard technique. Strontium was found to be the most suitable internal standard for general use. A Norelco Philips x-ray fluorescent spectrometer was used in this work, equipped with a lithium fluoride crystal acting as a diffraction-grating analyzer. The intensity of the uranium-L_{α_1} spectral line is calculated and related to corresponding strontium-Kα spectral line, both detected with a scintillation counter. Sources of error and interferences were investigated. The lower concentration limit is 0.01% of U_3O_8 and the standard deviation is 5.1 and 2.2% for a content of 0.1 and 0.5% of U_3O_8, respectively. Single determination can be made at about 15 min. (auth)

1357

DETERMINATION OF FLUORINE BY ALKALINE HYDROLYSIS OF URANIUM AND THORIUM FLUORIDES. M. Barrachina Gómez and L. Gascó Sánchez (Junta de Energia Nuclear, Madrid). Anales real soc. espãn fís. y quím. (Madrid), Ser. B 56, 589-96(1960) June. (In Spanish)

The alkaline hydrolysis of the uranium and thorium fluorides is studied, and a new method for the determination of the fluoride, on the basis of an indirect volumetric titration with standard soda, is proposed. The compounds that may influence the hydrolysis of the uranium fluoride and that may be occasionally found in it as impurities are also studied. The method can be applied to the uranium fluoride except when there is a great quantity of F_2UO_2 or UO_3 present in the sample. This method is always applicable in the case of thorium fluoride. (auth)

1358

IONIZATION DETECTORS FOR GAS CHROMATOGRAPHY. P. H. Stirling and Henry Ho (Canadian Industries Ltd. [Toronto]). Ind. Eng. Chem. 52, No. 11, 61A-2A; 64A(1960) Nov.

Ionization detectors were found to give better sensitivity in determining separation by gas chromatography because they respond directly to the sample molecules in the column effluent and are thus relatively independent of the carrier gas properties. The most effective ionizing process appeared to be collision of the sample molecules with metastable noble gas atoms. Argon, hydrogen flame, gas discharge, high vacuum, and beta ionization detectors are described. (M.C.G.)

1359

THE USE OF ORGANIC REAGENTS IN THE POLAROGRAPHIC DETERMINATION OF URANIUM AND ZIRCONIUM. Masayoshi Ishibashi, Taitiro Fujinaga, and Kosuke Izutsu (Univ. of Kyoto). J. Electroanal. Chem. 1, 26-38(1959-60) Aug. (In English)

In an attempt to find a suitable reagent for the polarographic determination of uranium and zirconium, various di-o-hydroxyazo and o-hydroxy-o'-aminoazo dyes were tested. Mordant Blue 2 R was found to be the most suitable. The influence of various factors, such as pH, concentration of the supporting electrolyte, temperature, and the presence of other elements, was investigated. The determination procedures are described, as well as methods for removing interfering ions. (auth)

1360

THE DETERMINATION OF MIXTURES OF IRON AND CERIUM BY CONTROLLED POTENTIAL COULOMETRIC ANALYSIS WITH A PLATINUM ELECTRODE. Donald G. Davis (Georgia Inst. of Tech., Atlanta). J. Electroanal. Chem. 1, 73-8(1959-60) Aug. (In English)

The method of controlled potential coulometric analysis was used for the reduction of several oxidants at a platinum electrode. Corrections are suggested for the surface oxidation of the electrode, and accurate results for mixtures of cerium and iron are reported. (auth)

1361

RADIOCHEMICAL ANALYSIS OF INDIVIDUAL FALL-OUT PARTICLES. J. Mackin, P. Zigman, D. Love, D. MacDonald, and D. Sam (Naval Radiological Defense Lab., San Francisco). J. Inorg. & Nuclear Chem. 15, 20-36(1960) Sept. (In English)

Quantitative measurements were made of the radioactivity of individual fall-out particles from a nuclear detonation at the Eniwetok Proving Grounds. These measurements were possible since individual particles that represented approximately 10^{10} or more fissions were obtained. Although several types of particles were observed, the data were generally resolved as being derived from two major particle classes depending upon whether or not the coral had undergone an obvious physical alteration such as melting. A number of individual particles were radiochemically analyzed for the nuclides Mo^{99}, Ba^{140}–La^{140}, Sr^{89}, and Np^{239}. The data obtained, together with γ-spectral and decay measurements, indicate that fractionation of radionuclides was prominent in the fall-out particles. Measured R values for Ba^{140} and Sr^{89} based on Mo^{99} were over an order of magnitude lower in the altered particles than in the more normal appearing or unaltered particles. The fissions/gram values of altered particles averaged 100 times that of unaltered particles. γ-Decay curves of the two classes of particles taken from H + 50 to H + 10,000 hr showed marked dissimilarities. (auth)

1362

RADIOMETRIC ESTIMATION OF TRACES OF ZIRCONIUM. K. R. Kar and B. C. Sawhney (Delhi Univ.). J. Sci. Ind. Research (India) 19B, 401-3(1960) Oct. (In English)

A radiometric method for estimating traces of zirconium (~ 2μg), alone or in the presence of Ce^{4+} and lanthanum, was developed. The method involves radiometric estimation of the quantity of phosphorus removed from a standard pyrophosphate solution (tagged with P^{32}) by the unknown sample of zirconium as the insoluble ZrP_2O_7. By knowing the specific activity of the precipitant pyrophosphate solution before and after precipitation of ZrP_2O_7, the amount of phosphorus thus separated and hence the amount of zirconium present in the unknown sample are determined. Silver iodide, produced in situ in 0.4N nitric acid and containing an excess of iodide is used as the carrier. For the estimation of zirconium in the presence of Ce^{4+} and lanthanum, silver thiocyanate is used as the carrier. In order to avoid interference by Ce^{4+}, the latter is reduced with a little hydrogen peroxide before the precipitation of ZrP_2O_7. A single estimation can be carried out within 90 min with an accuracy of ±1.0 per cent. (auth)

1363

X-RAY FLUORESCENCE METHOD FOR DETERMINATION OF THE TRANSITION-METAL CONTENT IN VERY SMALL SPECIMENS OF ALLOYS. P. J. Brown (Cavendish Lab., Cambridge, Eng.). J. Sci. Instr. 37, 394-7(1960) Oct.

A method is described for the quantitative determination of the transition metal content in very small quantities of alloys containing transition metals of the first long period. The method depends upon measurement of the intensity of the fluorescent x rays emitted by the specimen, and the results are evaluated by comparison with a series of standards. An accuracy of better than 1% can be achieved in specimens containing as little as 0.2 mg of the transition metals. (auth)

1364

MASS SPECTROMETRIC ANALYSIS OF THE URANIUM FISSION-PRODUCT CESIUM AND RUBIDIUM. M. P. Glazunov and V. A. Kiselev (Inst. of Physical Chemistry, Academy of Sciences, Moscow). Kernenergie 3, 869-70 (1960) Sept. (In German)

A description is given of the mass spectrometric analysis of cesium and rubidium originating from the fission of U^{235}. The ions of cesium and rubidium were produced by a thermal ion source, and the concentration of rubidium in the sample was found to be 3.2 ± 0.3 mg/l using an isotope dilution method. (auth)

1365

SAMPLING FOR MASS SPECTROMETRIC DEUTERIUM ANALYSIS. G. Hübner (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 888-90(1960) Sept. (In German)

A method is given for measuring the deuterium concentrations in samples of water of 3 to 5 mg only. The possible errors are discussed. The error caused by the contamination of the samples of water by the atmospheric humidity is highly important. Conditions are described to avoid these errors. (auth)

1366

METHODICS OF ISOTOPE ANALYSIS IN GEOLOGICAL SAMPLES FOR O^{18} AND C^{13}. R. Vedder (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 890-2(1960) Sept. (In German)

For the isotopic analysis of carbon and oxygen in carbonate rocks the carbon dioxide must be released from the carbonate. The relative abundances of C^{13} and O^{18} are measured mass-spectrometrically. Various methods for the decomposition of carbonate rocks, problems of possible isotopic exchange reactions, and isotopic

fractionation processes are discussed. Especially the acid and thermal decomposition are used. (auth)

1367
ANALYSIS OF HEAVY WATER BY DENSITOMETRIC METHODS. Tsing-lien Tschang (Univ. of Peking). Kernenergie 3, 892-7(1960) Sept. (In German)

The applicabilities of the falling drop method (I), the temperature gradient method (II), and the density gradient method (III) for analysis of D_2O are described. For (I) a new model of micropipet and new media for the determination of the concentration in the range of 0 to 100% D_2O are proposed. For (II) different models of floats were studied and, furthermore, a method for normalization of O^{18} content by CO_2 for simultaneous determination of D and O^{18} was elaborated. The distribution of isotopes in some natural waters of China was measured in this way. For (III) a new system of fluids, xylene-bromobenzene for the density gradient tube is suggested. (auth)

1368
DENSIMETRIC DETERMINATION OF DEUTERIUM AND O^{18} CONCENTRATION IN WATER BY THE FALLING-DROP METHOD. E. Krell (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 897-902(1960) Sept. (In German)

Independent of mass spectrometry, the isotopic analysis of particular elements can be carried out by special methods. For the determination of the deuterium concentration or O^{18} concentration, the falling-drop method is one of the most advantageous. After giving the theoretical basis an apparatus with a new principle of thermostating, granting a constancy of ±0.001°C, is described. A new medium, benzoic acid isobutyl ester $C_{11}H_{14}O_2$, shows a high constancy and can be used for a range of 0 to 4% D or O^{18}, respectively. In the range of 1 to 4% the method gives an accuracy of ±2γ corresponding to a relative error of ±0.18 to 0.04%. (auth)

1369
UV SPECTROSCOPIC N^{15} DETERMINATION WITH STEP FILTERS. H. Faust. Kernenergie 3, 902(1960) Sept. (In German)

In determining the relative abundance of the isotope N^{15} by ultraviolet spectroscopy a "Stufenfilter" is used for measuring the intensities of spectra of isotopic N_2 molecules. The method is rapid, rather independent from disturbances, and reproducible. With its accuracy of ±2% the method is sufficiently exact for most analytical purposes. (auth)

1370
SPECTROSCOPIC ISOTOPE ANALYSIS OF NITROGEN USING A SECONDARY ELECTRON MULTIPLIER. G. Meier (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 903-6(1960) Sept. (In German)

A direct photometric method for the isotopic analysis of nitrogen is shown. The intensity of the bandhead (0.1) of the N_2^{14} and $N^{14}N^{15}$ molecules in the second positive system of nitrogen is measured by use of a photomultiplier. The advantage of this method is the short time required for an analysis and the independence of photographic plates. (auth)

1371
ACCURACY IN MASS SPECTROMETRIC ISOTOPE ANALYSIS. H. Birkenfeld (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 906-10(1960) Sept. (In German)

In the mass spectrometric determination of relative abundances of isotopes some methodical errors are possible, for instance by insufficient resolution, preseparation in the ion source or the inlet system, memory effect, or contaminated samples. The nature of these errors, the evaluation of their quantitative influence, and possibilities of elimination in isotopic analysis are reported. (auth)

1372
HYDROGEN–DEUTERIUM ANALYSIS WITH THE RUSSIAN MASS SPECTROMETER MI-1301. H. Birkenfeld (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 910-13(1960) Sept. (In German)

The mass spectrometer type MI 1301 is unsatisfactory for isotopic analysis of hydrogen. Variations of the inlet part and of the measuring of ion flow, especially the improvement of ion yield by installation of pole shoes direct into the ion source, are accomplished. Thus it was possible to realize isotopic analysis of hydrogen in the range of natural abundance of deuterium. (auth)

1373
EXPERIENCE WITH MASS SPECTROMETRIC ISOTOPE ANALYSIS OF LEAD SAMPLES. H. Zahn (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 913-14(1960) Sept. (In German)

A report is given of the experiments that were made in the mass spectrometric analysis of lead isotopes in various compounds. Lead was evaporated in the form of its halides in a furnace ion source. After elimination of the vapor of mercury the relative error in the relative abundances of the isotopes of lead was <1%. (auth)

1374
METHOD OF SIMULTANEOUS DETERMINATION OF SMALL SODIUM AND POTASSIUM AMOUNTS BY NEUTRON ACTIVATION. Lesław Adamski, Jacek Bouzyk, and Krystyna Józefowicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 317-27(1960). (In Polish)

A method for simultaneously determining small amounts of sodium and potassium by neutron activation was developed. The content of these elements was determined in a hydrochloric acid sample obtained from the potassium chloride by the ion exchange. Gamma-spectroscopy, as well as a beta-ray absorption method, was used. The extrapolated sensitivities were 10^{-7} g Na and 10^{-5} g K. Mean error was estimated to be less than 20%. (auth)

1375
SCINTILLATION RADIOAUTOGRAPHY OF TRITIUM-LABELLED COMPOUNDS ON PAPER CHROMATOGRAMS. E. V. Parups, I. Hoffman, and H. R. Jackson (Dept. of Agriculture, Ottawa). Talanta 5, 75-7(1960) Aug. (In English)

A simple scintillation radioautographic method using ordinary fast photographic film was developed for tritium-labeled compounds on paper chromatograms impregnated with anthracene. Tritium analysis can now be undertaken by any laboratory without special equipment or controlled conditions. (auth)

1376
SPECTRAL DETERMINATION OF DEUTERIUM POOR CONCENTRATIONS IN HYDROGEN. A. N. Zaidel and G. V Ostrovskaya. Vestnik Leningrad. Univ. 14, No. 16, Ser. Fiz. i Khim. No. 3, 39-42(1959). (In Russian)

The method of spectral isotopic analysis of hydrogen was applied in determining the deuterium content of hydrogen at concentrations down to 0.015%. (auth)

General Inorganic and Physical Chemistry

1377 ANL-6200(p.16-18)
Argonne National Lab., Ill.
PRECISION MEASUREMENT BEYOND THE LIMIT OF

RESOLUTION WITH TRIANGULAR ARRAYS. Herbert E. Kubitschek.

A rapid optical method is described for measurement of the mean diameters of monodisperse spherical particles, which may then be used as size standards in the microscopic range. Provided that the particles are found or arranged in two-dimensional triangular arrays, the method can be applied with extreme precision even to particles beyond the limit of resolution, and it also allows the determination of variation in particle size. The method consists simply of measuring the length of a line of particles in the array. Although to date only standard spherical monodisperse polystyrene particles have been sized, the method is applicable in principle to the study of spherical viruses and macromolecular crystals. The experimental determination of the correction factor for the true mean diameter is discussed. (C.H.)

1378 CRCE-967

Atomic Energy of Canada Ltd., Chalk River, Ont.

DEUTERATION AND DEDEUTERATION OF PROTOTYPE NPD-2 RESIN COLUMNS. E. E. Winter and L. G. Cornett. Aug. 1960. 24p. (AECL-1094). AECL.

The deuteration of NPD-2 resin columns and dedeuteration by light water displacement were studied and optimum displacing velocities determined. A method of calculating longitudinal dispersion coefficients from effluent concentration profiles is presented and agreement established with previously reported results using other systems and column arrangements. A method is outlined for estimating effluent concentration profiles from bed packing characteristics and column dimensions. (auth)

1379 CVNA-54

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

THE TRANSPORT AND THERMODYNAMIC PROPERTIES OF SATURATED AND COMPRESSED HEAVY WATER. A. A. Bishop. July 1960. 58p. For Carolinas Virginia Nuclear Power Associates, Inc. OTS.

Thermodynamic and transport properties of heavy water found in recent literature were reviewed. Graphs and tables containing values of these properties were compiled from the data found. By assuming that pressure has the same relative effect on a thermodynamic or transport property of heavy water that it has on the corresponding property of light water at a given temperature, the desired properties of compressed heavy water were obtained and tabulated. Estimated accuracies of the data are included wherever this information was found. This report supersedes WCAP-1165 "Transport and Thermodynamic Properties of Saturated and Compressed Heavy Water." (auth)

1380 NYO-8119(Del.)

Franklin Inst. Labs. for Research and Development, Philadelphia and International Business Machines Corp., Poughkeepsie, N. Y.

THE DETERMINATION OF STRAIN AND CRYSTALLITE SIZE IN CaF_2 POWDERS FROM THE DATA OF A SINGLE X-RAY DIFFRACTION PROFILE. F. Witt, E. Klokholm, and R. S. Smith. Nov. 1958. 32p. Contract AT(30-1)-1484. OTS.

A method is derived to determine the root-mean square strain and average crystallite size of CaF_2 powders from the data of a single x-ray diffraction line profile. The Fourier coefficients of the pure x-ray diffraction line profile are the product of a strain coefficient and a crystallite size coefficient. Since the crystallite size coefficients are known to be linear for small values of the index "n," an accurate determination of the general Fourier coefficients enables the strain and crystallite size to be obtained. The method was checked on CaF_2 powder and yielded results comparable to those of the Warren-Averbach technique. (auth)

1381 AEC-tr-4108

THE URANIDES AND THEIR PHYSICAL HOMOLOGY. C. G. Bedreag. Translated from Analele stiint. univ. "Al. I. Cuza" Iasi, Sect. I (NS) 1, 231-42(1955). 13p. JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 10419.

1382 CEA-tr-R-988

POTENTIELS D'ÉQUILIBRE DES MÉTAUX DANS LES ÉLECTROLYTES FONDUS. (Equilibrium Potentials of Metals in Molten Electrolytes). M. V. Smirnov and L. D. Yushina. Translated into French by B. Vinogradoff from Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk No. 2, 251-8(1959). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 9743.

1383 UCRL-Trans-568(L)

AN INVESTIGATION OF THE INTERACTION OF MELTS OF THE SULFATES OF SODIUM, POTASSIUM, MAGNESIUM AND CALCIUM. S. M. Mukimov, N. I. Krylova, and A. G. Bergman. Translated by M. W. Nathans from Trudy Inst. Khim. Akad. Nauk Uzbek. S.S.R. No. 2, 94-112(1949). 22p. JCL or LC.

Phase studies were conducted on the interaction of sodium, potassium, magnesium, and calcium sulfates at ~800 to ~1100°C. The surface of crystallization of the system of potassium, magnesium, and calcium sulfates was determined. It was established that two compounds exist in the $K_2SO_4-CaSO_4$ system; tentative formulas of $3CaSO_4 \cdot K_2SO_4$ and $2CaSO_4 \cdot K_2SO_4$ were suggested. (C.J.G.)

1384

ABSORPTION SPECTRA OF MOLTEN FLUORIDE SALTS. SOLUTIONS OF PRASEODYMIUM, NEODYMIUM, AND SAMARIUM FLUORIDE IN MOLTEN LITHIUM FLUORIDE. J. P. Young and J. C. White (Oak Ridge National Lab., Tenn.). Anal. Chem. 32, 1658-61(1960) Nov.

Spectra are presented for solutions of praseodymium, neodymium, and samarium fluoride in molten lithium fluoride at ~900°C. These data are discussed and compared to similar results that were obtained in other molten salts and aqueous solutions. Molar absorptivities for selected major absorbance peaks of these rare-earth spectra are given. (auth)

1385

FUSED SALTS. G. E. Blomgren and E. R. Van Artsdalen (Union Carbide Corp., Parma, Ohio). Ann. Rev. Phys. Chem. 11, 273-306(1960).

An extensive review of fused salts research is given, beginning with a brief historical survey and covering the following topics: (1) reviews on fused salts, (2) transport properties (viscosity, electric and thermal conductivities, transport numbers, and diffusion), and (3) equilibrium properties (vapor pressure, electromotive force, solubility, density, surface tension, spectroscopy, x-ray diffraction, and theory of fused salts). The present status of knowledge on fused salts is summarized; and it is emphasized that very little is known, especially of the nature of fused salts and reactions occurring therein. A bibliography of 258 references is given. (D.L.C.)

1386

HYPERFINE STRUCTURE, ZEEMAN EFFECTS, AND SEPARATION OF LINES IN TERBIUM SPECTRA. Sumner P. Davis (Univ. of California, Berkeley). Astrophys. J. 132, 486-92(1960) Sept.

Hyperfine structure splittings were measured for 232 lines in terbium spectra; Zeeman effects were measured for approximately 600 lines; and relative intensities in arc and spark spectra were estimated for approximately 3500 lines. The splittings form a practically continuous range of values within the limits of uncertainties of measurement. The ground states of Tb I and Tb II were not found; nearly 90% of the Zeeman patterns are unresolved. The relative intensity estimates may prove helpful for analysis. (auth)

1387

THE SEPARATION OF SOME INORGANIC IONS BY HIGH-VOLTAGE ELECTROMIGRATION IN PAPER. R. A. Bailey and L. Yaffe (McGill Univ., Montreal). Can. J. Chem. 38, 1871-80(1960) Oct.

A number of inorganic ions were separated by high-voltage electromigration in paper. The systems considered include some of particular radiochemical interest such as Sr–Y, Ba–La, Mo–Tc, Pb–Bi–Po; the alkali metals; some elements of the first long period; and other metals. Background electrolytes were usually solutions of complex-forming organic acids. (auth)

1388

CONCERNING THE ABSORPTION SPECTRUM AND THE LUMINESCENCE OF SOLUTIONS OF URANIUM COMBINATIONS. L. V. Volod'ko, A. N. Sevchenko, and D. S. Umreiko (Lenin State Univ., USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 749-51(1960) June. (In Russian)

The experimental absorption spectrum of a uranyl sulfate solution at room temperature is used as the basis for determining the basic absorption for uranium salts. The observed spectrum is compared to the spectrum of the various series for electronic states and vibrational frequencies for the UO_2^{2+} ion in the spectroscopic properties of uranium compounds of Dieke and Duncan. The application of mirror symmetry separates one of the electronic states. The integration of the absorption for quasi-symmetric states composes 10% of the total absorption in the visible part of the spectrum. The basic absorption by uranium salts at room temperature originates from the sigma–pi transition which is determined by the "magnetic" series. (TTT)

1389

THE EFFECT OF THE SURFACE OF THE ADSORBENT ON THE LUMINESCENCE OF URANYL IONS. G. I. Kobyshev (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 752-5(1960) July. (In Russian)

Uranyl ions on a surface are in a state of adsorption and crystalline salts are not formed. In a vacuum the surface adsorption is the uranyl dihydrate ion $(UO_2 \cdot 2H_2O)^{2+}$. For the dihydrate the luminescence sharply decreases and the structure of the spectrum of the luminescence indicates a coordination of the molecular ions of H_2O and NO_2 in the formation of the surface complex combination. The adsorption comes about as a result of the replacement of the proton in the hydroxyl group by an ion of uranium. The process of extinguishing the ions I^- and NO_2^- is described by the linear formula of Stern-Folmer. (TTT)

1390

AN INVESTIGATION OF THE LUMINESCENCE OF ION SPECIES OF FLUORESCING URANIUM. E. V. Grigoryan, L. T. Kantardzhyan, and C. C. Chirkinyan (Electro-Technical Inst., Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 771-5(1960) June. (In Russian)

An investigation of the luminescence spectrum of uranium in solutions with different pH was made with the aim of clarifying the role of singly charged anions upon the luminescence curves. Measurements were made by using the photoelectric method for uranium concentrations of 5×10^{-5} g/ml in solutions of water, ammonia, and different acids. Correlation between the change in the luminescence spectrum and the change in different ion species was noted; the significant effect of the solution itself upon the optical properties of the various ions complicates the analysis of the spectrum to determine the ion species of uranium in this particular spectral region (500 mμ). (TTT)

1391

SUBLIMATION OF Cr_2O_3 AT HIGH TEMPERATURES. Ke-Chin Wang, Lloyd H. Dreger, V. V. Dadape, and John L. Margrave (Univ. of Wisconsin, Madison). J. Am. Ceram. Soc. 43, 509-10(1960) Oct.

The sublimation of chromic oxide, Cr_2O_3, was observed in vacuum by the Langmuir technique using induction and solar heating. Extensive sublimation did not yield any new phases on the basis of x-ray powder studies, and condensates of Cr_2O_3 were always obtained. Flash vaporization and flow experiments in CO or O_2 atmospheres and in vacuum indicated no appreciable differences in rates of sublimation. Weight-loss experiments showed that the rate of sublimation was slightly higher than predicted for decomposition to the elements and suggested that small amounts of complex molecules (e.g., CrO and CrO_2) were also present in the equilibrium vapor. (auth)

1392

CUPROUS HALIDE FILMS ON ALKALI HALIDE CRYSTALS. L. M. Kraemer (Argonne National Lab., Ill. and Univ. of Chicago). J. Chem. Phys. 33, 991-3(1960) Oct.

Films of cuprous halides were formed by evaporation and condensation in a vacuum onto substrates of alkali halide crystals at room temperature. They were annealed for 15-min periods at temperatures between 60 and 150°C. Optical absorption spectra indicate that the annealing causes diffusion of CuCl and CuBr into KCl and KBr, but not into KI or NaCl, and of CuI into RbI, but not into KCl, KBr, KI, or NaCl. An interstitial mechanism for diffusion is consistent with the data but is not sufficient to account for the behavior of CuI. (auth)

1393

PARTITION FUNCTION RATIOS FOR MOLECULES CONTAINING NITROGEN ISOTOPES. G. M. Begun (Oak Ridge National Lab., Tenn.) and W. H. Fletcher (Univ. of Tennessee, Knoxville). J. Chem. Phys. 33, 1083-5(1960) Oct.

Nitrogen isotopic partition function ratios were calculated for the following molecules and ions: N_2, N_2O, NO, NOCl, NO_2, NO_2^+, NO_2^-, and N_2O_4. All available isotopic and and anharmonic data were used, and values of Q^{15}/Q^{14} are tabulated for temperatures at intervals from 100 to 600°K. Isotopic equilibrium constants calculated from the partition function ratios are compared with those that were observed experimentally. (auth)

1394

SOLUBILITY OF HYDROGEN AND DEUTERIUM IN LIQUID ARGON. H. Volk and G. D. Halsey, Jr. (Univ. of Washington, Seattle). J. Chem. Phys. 33, 1132-9(1960) Oct.

The solubility of hydrogen and deuterium in liquid argon at pressures from 10 to 100 atm is reported. Solubility isotherms were measured between 87 and 140°K for hydrogen and between 87 and 120°K for deuterium. The dependence of Henry's constant on temperature, pressure, and concentration, the heats of solution, the partial molar volume of hydrogen in liquid argon, and the second virial coefficients of hydrogen and deuterium in the liquid solution are reported. The increase in the solubility of deuterium over hydrogen is 21.3, 20.2, and 18.5%, respectively, at 87,

100, and 120°K. This isotope effect is discussed as a quantum correction to the free volume. Comparison between theory and experiment indicates that the LJD free volume is too large by approximately a factor of five. (auth)

1395

PRELIMINARY ANALYSIS OF U^{4+} ION SPECTRA IN CRYSTALS. Robert A. Satten (Univ. of California, Los Angeles), Donald Young, and Dieter M. Gruen. J. Chem. Phys. 33, 1140-51(1960) Oct.

An analysis of a number of features of the absorption spectra of U^{4+} ions in crystals is given. Absorption spectra of crystals of the compounds Cs_2UCl_6 and $[N(CH_3)_4]_2$ UCl_6, and to a lesser extent $[N(C_2H_5)_4]_2$ UCl_6, were studied at room temperature, liquid N_2, and liquid helium temperatures. The visible spectrum is essentially entirely vibronic. Pure electronic transitions are absent or very weak in thick crystals in agreement with a model of electric dipole transitions within the 5 f^2 shell at an equilibrium site of inversion symmetry. This is believed to be the first demonstrated case of an essentially purely vibronic spectrum reported for rare-earth or actinide salts. The three "ungerade" frequencies of the UCl_6^{2-} complex are coupled to the electronic frequencies and are determined by their appearance with the same frequency of superposition in all three salts as well as by being the most intense of the vibronic lines in every group in which they appear. Other lattice modes and internal frequencies of the tetramethylammonium ion are also found to be superimposed. The weak pure electronic transitions are fairly sharp, an indication that there is still considerable shielding in the 5 f^n electronic states even though this shielding is less than in 4 f^n states. The independence of superimposed vibration frequencies on 5 f^2 electronic states indicates the fact that the 5 f states do not contribute much to the binding. The similarity in the spectra of the three salts studied is due to the fact that the nearest-neighbor Cl^- ions are the principal origin of the crystalline field in contrast to the rare earths, wherein this type of similarity is due to the fact that the crystalline field is small and each group of lines represents a multiplet level of the free ion. Evidence is presented that the crystalline field splitting is larger than hitherto believed and is the same order of magnitude as the spin-orbit interaction. Methods of attacking the problem of the experimental classification and calculation of energy levels in the situation in which three major interactions are of comparable size are discussed. (auth)

1396

TRANSPORT PROCESSES IN LIQUID ALLOYS. II. THE ELECTRICAL FORCE ON AN ION. Paul C. Mangelsdorf, Jr. (Univ. of Chicago). J. Chem. Phys. 33, 1151-61(1960) Oct.

The electrolytic migration velocities of impurity ions in liquid metals suggest the existence of strong net electrical forces on these ions, although other mechanisms are possible. On the basis of a detailed model of a liquid metal, the early theory of Skaupy is revived and revised. In dilute solution a total electrical force, proportional to the conductivity increment produced by a solute, is exerted on the solute and on nearby solvent when the electric field is applied. The part of the force on the solute ion may be opposed to the part on the solvent. Implications for the resistivity of liquid alloys are discussed, including a possible effect in very dilute solutions when the solute ions are further apart than one mean free path. The effective number of free electrons in pure liquid mercury is provisionally estimated to be 0.3 per atom. (auth)

1397

ESTIMATION OF THE IONIZATION POTENTIAL AND DISSOCIATION ENERGY OF MOLECULAR ASTATINE. Robert W. Kiser (Kansas State Univ., Manhattan). J. Chem. Phys. 33, 1265-6(1960) Oct.

The ionization potential and dissociation energy are estimated for astatine from empirical correlations. From the ω_e values for the lighter halogens, the ω_e for At_2 is estimated to be 160 cm^{-1}, and a plot of these ω_e values on a log ω_e vs. log n^2I graph (n = principal quantum number) gives $I(At_2)$ 8.3 ev. The $D(At_2)$ is estimated to be 1.2 ev from a Mitra log D vs. log I plot. From a thermochemical cycle, $D(At_2^+)$ and I(At) are estimated to be 2.4 and 9.5 ev, respectively. (D.L.C.)

1398

EFFECT OF THERMAL TREATMENT OF PARAMAGNETIC RESONANCE SPECTRA OF RARE EARTH IMPURITIES IN CALCIUM FLUORIDE. E. Friedman and W. Low (Hebrew Univ., Jerusalem). J. Chem. Phys. 33, 1275-6(1960) Oct.

It was found by experiment that axial and cubic point-symmetries of rare earths in CaF_2 may be changed into the other by annealing processes. The experiments were performed on CaF_2 crystals containing 0.01 to 0.001% gadolinium, by heating them in a furnace to 1200°C, holding at this temperature for 18 hr, and then cooling. Slow cooling (100°/hr) was found to result in gadolinium having axial symmetry; whereas quenching from 1200°C to room temperature in 1 to 2 hr gave cubic symmetry. Heating at 1200°C for a short period or at low temperatures gives incomplete conversion of cubic into axial symmetry. It is concluded that excess F^- ions are not tightly bound to the cube nearest the impurity at high temperatures and, under quenching conditions, have no time to diffuse to the energetically stable sites near the impurity. (D.L.C.)

1399

SIZE EFFECTS AMONG ISOTOPIC MOLECULES. Hubert W. Joy and W. F. Libby (Univ. of California, Los Angeles). J. Chem. Phys. 33, 1276(1960) Oct.

It is known that equilibrium constants for isotopic reactions are temperature-dependent owing to energy differences in zero-point energy, but it is less well-known that there is a possible pressure effect owing to volume differences in the zero-point state. For example, for the reactions $H_2O^{18} + CaCO_3 \rightarrow H_2O + CaCO_3^{18}$ (calcite), the volume change is calculated from the frequency shift to be 0.14 cc/mole, and $\delta \ln k/\delta P = +1.9 \times 10^{-6}$ atm^{-1} at 298°K. This means that a change in k should be measurable in the laboratory at high pressures. (D.L.C.)

1400

SOLVATES OF URANIUM TETRACHLORIDE WITH PHOSPHORUS OXYCHLORIDE. R. E. Panzer (Univ. of New Mexico, Albuquerque) and J. F. Suttle. J. Inorg. & Nuclear Chem. 15, 67-70(1960) Sept. (In English)

Two compounds of uranium tetrachloride and phosphorus oxychloride, the solvates $UCl_4 \cdot 4POCl_3$ and $UCl_4 \cdot POCl_3$, are reported. The tetra-solvate is an aqua-green tetragonal crystalline material with indices of refraction of $n_e = 1.645$, $n_o = 1.657$. The material melts at 340°C (closed tube), following partial liquefaction and resolidification at 118°C. The mono-solvate $UCl_4 \cdot POCl_3$ was prepared from the tetra-solvate by gentle heating under high vacuum. This material is light blue-green. Its symmetry class is unknown. Indices of refraction are: maximum index, 1.660; minimum index, 1.645. It occurs in irregularly shaped crystals. Powder x-ray data are re-

ported for these two compounds. The possible existence of other solvates in the series is discussed. (auth)

1401

THE REACTION OF URANIUM OXIDES WITH DINITROGEN PENTOXIDE. G. Gibson, C. D. Beintema, and J. J. Katz (Illinois Inst. of Tech., Chicago and Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem. 15, 110-14(1960) Sept. (In English)

UO_3 reacts with N_2O_5 (liquid) containing N_2O_4 to give a mixture of $UO_2(NO_3)_2 \cdot N_2O_5$ and $UO_2(NO_3)_2 \cdot 2NO_2$. This reaction is erratic; many times only a partial conversion of the oxide is attained. A procedure for preparing NO_2-free N_2O_5 by the oxidation of NO_2 by ozone is described; this procedure is more satisfactory than the dehydration of HNO_3 by P_2O_5. CCl_4 as a solvent for the $UO_3-N_2O_5$ system apparently yields mixtures of $UO_3-UO_2(NO_3)_2$ and $UO_3-UO_2(NO_3)_2 \cdot N_2O_5$ and/or $UO_2(NO_3)_2$; similarly, 100% HNO_3 as solvent reacts completely with UO_3 to yield mixtures of $UO_2(NO_3)_2 \cdot N_2O_5$ and $UO_2(NO_3)_2 \cdot 2HNO_3$. The mole excess of N_2O_5 used does not affect the product obtained as in the preparation of $Th(NO_3)_4 \cdot 2N_2O_5$. $UO_3(NO_3)_2 \cdot xN_2O_5$, where x = 0.99 to 1.09, may be prepared by the reaction of UO_3 with solid N_2O_5, provided that the particle size of the oxide is small (pass 325 mesh) and the mixture is vigorously stirred. $UO_2(NO_3)_2 \cdot N_2O_5$ may be thermally decomposed to $UO_2(NO_3)_2$, and its thermal stability is less than that of $UO_2(NO_3)_2 \cdot 2NO_2$. (auth)

1402

THE INFRA-RED SPECTRUM OF $Th(OH)_4$. C. W. F. T. Pistorius (Univ. of California, Los Angeles). J. Inorg. & Nuclear Chem. 15, 187-8(1960) Sept. (In English)

The infrared spectrum of $Th(OH)_4$ was measured using the KBr pressed-pellet and the Nujol mull techniques in the range 8 to 15 μ and 2 to 15.5 μ, respectively. The results are tabulated and compared with those previously obtained. The peaks observed are discussed in connection with the symmetry of the molecular structure. (B.O.G.)

1403

DIFFUSE REFLECTANCE MEASUREMENTS ON BULK URANIUM DIOXIDE. A. Companion (Illinois Inst. of Tech., Chicago) and G. H. Winslow. J. Opt. Soc. Am. 50, 1043-5 (1960) Nov.

Diffuse reflectance measurements were made on powdered uranium dioxide samples to which varying amounts of excess oxygen were added. The principal purpose was to demonstrate that the optical constants and the description of the effects of excess oxygen on the absorption coefficient, which were previously derived from studies of thin films of UO_2, apply also to bulk material. The reflectance method is rather insensitive for highly absorbing material, but it is believed that the objective was achieved. The characteristics of the reflectance method that tend to limit its easily useful application to material with small absorption coefficients are discussed briefly. (auth)

1404

ELECTROMOTIVE FORCE MEASUREMENTS IN AQUEOUS SOLUTIONS AT ELEVATED TEMPERATURES. II. THERMODYNAMIC PROPERTIES OF HYDROCHLORIC ACID. R. S. Greeley, William T. Smith, Jr., M. H. Lietzke, and R. W. Stoughton (Oak Ridge National Lab., Tenn. and Univ. of Tennessee, Knoxville). J. Phys. Chem. 64, 1445-8(1960) Oct.

The mean ionic activity coefficient, relative partial molal heat content, relative partial molal heat capacity, and osmotic coefficient of hydrochloric acid were calculated from emf data for concentrations from 0.001 to 1.0m at temperatures from 25 to 200°C and in some cases to 275°C. The extended Debye-Hückel equation was shown to represent the data about as well at temperatures to 275°C as at room temperature. (auth)

1405

KINETICS OF THE REACTION BETWEEN PLUTONIUM(IV) AND TIN(II). S. W. Rabideau (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 64, 1491-6(1960) Oct.

In the reaction between Pu(IV) and Sn(II), it was found that parallel paths are involved in the rate-determining steps and that four and five chloride ions participate in the formation of the activated complexes. The rate law can be written as $-d[Sn(II)]/dt = k_1[Sn(II)]\,[Sn^{2+}]\,[Cl^-]^4 + k_2[Pu^{4+}]\,[Sn^{2+}]\,[Cl^-]^5$; at 25°C the values of the specific rate constants k_1 and k_2 are 720 M^{-5} sec^{-1} respectively. At 25°C for the process, $Pu^{4+} + Sn^{2+} + 4Cl^- = (Pu \cdot Cl_4 \cdot Sn)^{2+}$, $\Delta H^* = 26.9$ kcal/mole, and $\Delta S^* = 44.7$ eu. For the parallel reaction at 25°C, $Pu^{4+} + Sn^{2+} + 5Cl^- = (Pu \cdot Cl_5 \cdot Sn)^+$, $\Delta H^* = 24.1$ kcal/mole, and $\Delta S^* = 37.0$ eu. These reactions were found to be hydrogen ion independent over the range of acidity studied. The positive correlation between the charge and the entropy of the activated complex was extended to include charge types of +1 and +2. (auth)

1406

THE EQUILIBRIUM: $\frac{2}{3}$ Bi(1) + $\frac{1}{3}$ $BiBr_3$(g) = BiBr(g) AND THE THERMODYNAMIC PROPERTIES OF $BiBr_3$. Daniel Cubicciotti (Stanford Research Inst., Menlo Park, Calif.). J. Phys. Chem. 64, 1506-8(1960) Oct.

The reaction $\frac{2}{3}$ Bi(1) + $\frac{1}{3}$ $BiBr_3$(g) = BiBr(g) was studied by a transpiration technique in the range 600 to 700°C. The enthalpy change for the reaction was found to be 21.3 kcal. This was used to derive a standard enthalpy of formation of solid $BeBr_2$ of −63 kcal/mole at 298°K. The measured entropy of the reaction of 17 eu agreed well with a calculated value. (auth)

1407

THE KINETICS OF THE OXALATE CATALYSIS OF THE IRON(II)−IRON(III) ELECTRON-EXCHANGE REACTION IN AQUEOUS SOLUTION. R. A. Horne (Brookhaven National Lab., Upton, N. Y. and Columbia Univ., New York). J. Phys. Chem. 64, 1512-17(1960) Oct.

The kinetics of the electron-exchange reaction between the two oxidation states of iron is first order in both iron(II) and iron(III) and oxalate-catalyzed in aqueous perchloric-oxalic acid media of 0.55 ionic strength. The specific reaction rate constants for the reaction path involving ferrous ion and $FeC_2O_4^+$ are 700, 1100, and 2140 sec^{-1} f^{-1} at 0.10, and 20°C respectively, corresponding to an activation energy of 9.2 kcal $mole^{-1}$ and an entropy of activation of −14.1 kcal/$mole^{-1}$ deg^{-1}. The specific reaction rate constants for the path involving ferrous ion and $Fe(C_2O_4)_2^-$ are in the range 2500 to 4500 sec^{-1} f^{-1}. The exchange is also catalyzed by silver foil and by acetate, succinate, and phenolate anions. (auth)

1408

THE PREPARATION, CRYSTAL STRUCTURES AND SOME PROPERTIES OF ZIRCONIUM AND HAFNIUM DIRHENIDE. N. H. Krikorian, W. G. Witteman, and M. G. Bowman (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 64, 1517-19(1960) Oct.

The preparation of near stoichiometric zirconium dirhenide ($ZrRe_2$) and hafnium dirhenide ($HfRe_2$) by direct combination of the elements is described. The melting temperature for $ZrRe_2$ was found to be 2750 ± 50°C and for $HfRe_2$, 2935 ± 75°C. Both compounds have a hexagonal C-14 Laves Structure: $ZrRe_{2.01}$ $a_0 = 5.2701 \pm 0.0004$, $c_0 = 8.6349 \pm 0.0008$; $HfRe_{2.02}$ $a_0 = 5.2478 \pm 0.0002$, $c_0 = 8.5934 \pm 0.0006$. These dirhenides are extremely hard, having a

DPH of 1400 for each. Both dirhenides were found to convert to the monocarbides of hafnium and zirconium in the presence of graphite at about 2150°C. (auth)

1409

THE DISSOCIATION PRESSURES AND THE HEATS OF FORMATION OF THE MOLYBDENUM SILICIDES. Alan W. Searcy and A. G. Tharp (Univ. of California, Berkeley and Purdue Univ., Lafayette, Ind.). J. Phys. Chem. 64, 1539-42(1960) Oct.

Silicon partial pressures for dissociation of the three molybdenum silicides were measured by the Knudsen effusion method. The heats of dissociation per gram atom of silicon vapor were calculated at 298°K take for Mo_3Si, 131.9 ± 1.2 kcal; for Mo_5Si_3, 131.1 ± 0.7 kcal; and for $MoSi_2$, 117.2 ± 0.6 kcal. The heats of dissociation of the molybdenum silicides when combined with the heat of sublimation of silicon yielded the following heats of formation at 298°K: Mo_3Si; −23.5 ± 4 kcal; $\frac{1}{3}$ Mo_5Si_3, −22.6 ± 5 kcal; $\frac{1}{2}$ $MoSi_2$, −13.0 ± 5 kcal. (auth)

1410

CERTAIN TRANSPORT PROPERTIES OF BINARY ELECTROLYTE SOLUTIONS AND THEIR RELATION TO THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES. Donald G. Miller (Univ. of California, Livermore). J. Phys. Chem. 64, 1598-9(1960) Oct.

The vector transport properties of binary electrolytes can be expressed in terms of the thermodynamics of irreversible processes by means of the Onsazer coefficients. The defining equations for these properties together with the expression for the flows of cations and anions based on the solvent-fixed reference frame were solved for transference number and specific conductance. Some preliminary values of L_{12}/C and L_{12}/I, where I is ionic strength, C is molarity, and L_{12} is interionic interaction, were calculated from experimental data at 25°C for 1-1, 2-1, and 3-1 electrolytes. (M.C.G.)

1411

STUDY OF REACTION MECHANISMS PRODUCING HYDROGEN PEROXIDE AND PEROXY ACIDS BY ISOTOPE METHODS. A. I. Brodskiĭ (Pisarzhevskiĭ Inst. of Physical Chemistry, Academy of Science, Ukrainian SSR). Kernenergie 3, 822-7(1960) Sept. (In Russian)

In the auto-oxidation of 2-ethyl-anthrahydroquinone with O_2^{18}, the marked ion is found back in $H_2O_2^{18}$. It was shown by labeling OH groups with deuterium that no hydrogen goes into the aromatic nucleus. In the auto-oxidation of isopropylalcohol with O_2^{18}, this O_2^{18} is found in the formed H_2O_2 but not in the formed acetone. A mechanism is given. In the auto-oxidation of acetic aldehyde, butyl aldehyde, benzene aldehyde, or o-chlorobenzene aldehyde with regular O_2, the formed acids contain one oxygen atom from the aldehyde and one oxygen atom from the oxygen. Therefore it must be accepted that a peroxide interstage is rupturing its O−O bond. By a cathodic reduction of oxygen on a carbon-nickel electrode, the H_2O_2 is obtained from this oxygen without participation of the oxygen of water. By an isotopic dilution method with $H_2O_2^{18}$ to oxygen and water, it has been shown that the moist atmospheric corrosion of Mg, Zn, Cd, Al, and Sn has an intermediate state of H_2O_2, like the electrochemical equation of the cathodic depolarization. The anodic formation of persulfate, percarbonate, and perphosphate proceeds without participation of the oxygen of water. By means of an isotopic dilution method with $H_2O_2^{18}$, it was shown that the H_2O_2 has no intermediate state in the formation of persulfate. In the electrolysis of borates in presence of carbonates, no perborates were formed but only the perhydrates of borates. In the hydrolysis of persulfates, percarbonates, perborates, and perphosphates with H_2O^{18}, the formed H_2O_2 had no labeled oxygen. In the thermolysis the participation of the oxygen of water depends on the pH value of the solution. (auth)

1412

STUDY OF MECHANISMS OF CERTAIN OXIDATION-REDUCTION REACTIONS BY ISOTOPE METHODS. A. I. Brodskiĭ (Pisarzhevskiĭ Inst. of Physical Chemistry, Academy of Science, Ukrainian SSR). Kernenergie 3, 827-33(1960) Sept. (In Russian)

By the aid of O^{18}, the following oxidations were investigated: $AgNO_3 \rightarrow Ag_2O_2$, $MnCl_2 \rightarrow MnO_2$, $PbS \rightarrow PbSO_4$, and $H_2O_2 \rightarrow O_2$. In these reactions electrons transfer from the oxidated ion to peroxidisulfate by fission of the O−O bond and formation of sulfate. In case of Ag_2O_2 and MnO_2, the oxygen came from the water. In the oxidation of $MnCl_2$ with H_2O_2, there is the same mechanism, but, in the oxidation of PbS to $PbSO_4$ with $H_2O_2^{18}$, the oxygen came from $H_2O_2^{18}$. In the oxidation of aniline, o-anisidine; or p-nitraniline to nitrobenzene, o-nitrosoanisole, or p-nitronitrosobenzene with Caro's acid in presence of H_2O^{18}, reaction products have only natural abundance of O^{18}. If products can transform themselves to quinone structure (9), isotope exchange is possible in the nitroso groups, for instance in p-nitrosophenol or α-nitroso-β-naphthol. Subsequent of a catalytic oxidation of allyl alcohol and hydrolysis of the formed epoxides with H_2O_2 in presence of H_2O^{18} and H_2WO_4, H_2MoO_4 or $H_2SeO_3O^{18}$ is found to 85 to 90% in the glycerol-1-(O^{18}) and to 15 to 10% in the glycerol-2-(O^{18}). In the decomposition of chromylchloride complexes of cyclohexene and benzene with H_2O^{18}; there is resulting chlorocyclohexanol and benzoquinone without O^{18} more than natural abundance. Therefore oxygen came from CrO_2Cl_2. Triphenylmethane has the same mechanism in oxidation; nevertheless the resulting triphenylcarbinol is containing O^{18}, but this came from triphenylmethylchloride by hydrolysis. It was shown that all these complexes have an esterlike structure, but not in the case of o-nitrotoluene. By the action of KOH^{18} on o-nitrotoluene or to potassium salt of 2-nitrotoluene-4-sulfonic acid, resulting anthranil- or anthranil-sulfonic acid, has one oxygen from the alkali and the other oxygen from the nitro group. These results are in opposition to earlier accepted mechanisms of anthranilic acid rearrangement and suggest an intermediate state of anthranile. It was shown by means of deuterium that in some important reduction reactions, the hydrogen came from a C−H bond of the reducing agent but not from an O−H bond. For some reactions the kinetic isotope effect of hydrogen (k_H/k_D = 1.4 − 2.0) was found abnormally small. (auth)

1413

USE OF O^{18} FOR DETERMINATION OF BOND STRENGTHS OF OXYGEN IN THE CRYSTAL LATTICES OF SOLIDS. Vikt. I. Spitsyn (Spicyn, Spitzin) and V. G. Finikov (Inst. of Physical Chemistry, Academy of Sciences, Moscow). Kernenergie 3, 834-6(1960) Sept. (In German)

The energy of activation for isotope exchange reactions between oxygen and solids containing oxygen is a measure for the bond strength of oxygen in the solid. From an examination of the rate of isotope exchange between oxygen and sulfates of the alkali metals at temperatures from 680 to 820°C, it is stated that the bond strength of oxygen has a maximum at K_2SO_4, decreasing both toward lithium and cesium. In K_2SiO_3 and SiO_2, the bond strength of oxygen is greater, in $K_2Si_2O_5$, smaller than in K_2SO_4. The isotope exchange between oxygen and Na_2SO_4 is accelerated by β rays emitted by S^{35} joined to the anion. (auth)

1414

O^{18} EXCHANGE BETWEEN WATER AND INSTRUMENT GLASS. I. Maass (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 843-6(1960) Sept. (In German)

In investigations with H_2O^{18}, unexplainable differences in the isotopic analysis of oxygen resulted. Therefore the isotopic exchange between H_2O^{18} and the surface of the two kinds of glass was investigated. The effect of temperature, time of action, and quantity of water was measured. A measurable exchange was found only above 100°C. (auth)

1415

A NEW CASE OF CRYSTALLOGRAPHIC STACKING FAULT: U_3O_{8-x}. Ryoitiro Sato (Mitsubishi Metal Mining and Metallurgical Lab., Omiya City, Japan). Nature 188, 222-3(1960) Oct. 15.

A new case of fault structure was detected in U_3O_8 which is connected with a chemical decomposition. Electron diffraction patterns of a single crystal of orthorhombic U_3O_8 are given. Successive stages of line-up of U-planes in the reduction of U_3O_8 to U_3O_{8-x} are illustrated. This illustrates the changes through which the orthorhombic lattice of U_3O_8 proceeds to the cubic lattice of UO_2. Prior to the appearance of the UO_2 phase the comparatively weaker spots suffer an anomalous splitting that can be accounted for by stacking faults, the amount of splitting dependent on the value of M—the step at which stacking faults take place in the U^{6+} plane. (B.O.G.)

1416

FLUORINE PRODUCTS AND N-ENERGY. II. THE PROPERTIES AND APPLICATIONS OF FLUORINE. Nuclear Energy, 317-18; 320(1960) July.

A short discussion of fluorine and its handling and role in nuclear energy is given. A table of metals and their suitability for handling fluorine is presented together with specific recommendations, e.g., on joints, rotameters, safety, and disposal. Fluorine is used in nuclear energy in the following ways: UF_6 is used in the gaseous diffusion separation of U isotopes and is very well suited for that purpose. ClF_3 and BrF_3 are used in the reprocessing of spent fuel elements; the resulting fluorides are separated by distillation. UO_2F_2 can be used in the form of an aqueous solution for a fuel for homogeneous reactors. ThF_4 is used in the recovery of thorium from monazite. LiF is the best lithium salt for neutron detecting purposes. (D.L.C.)

1417

INFRARED AND RAMAN SPECTRA OF CHROMYL CHLORIDE. F. A. Miller, G. L. Carlson, and W. B. White (Mellon Inst., Pittsburgh). Spectrochim. Acta 15, 709-16 (1959).

The infrared spectrum of CrO_2Cl_2, a deep red liquid, was measured from 120 to 3000 cm^{-1}. Six Raman lines were obtained by excitation with the D-lines of potassium. The fundamental frequencies for C_{2v} symmetry are a_1 = 981, 465, 356, 140; a_2 = 224; b_1 = 995, 211; and b_2 = 496, 257. The results agree well with the work on the Raman spectrum by Stammreich et al. Thermodynamic properties were calculated at four temperatures. (auth)

1418

INFRARED AND RAMAN SPECTRA OF TITANIUM TETRABROMIDE. Foil A. Miller and Gerald L. Carlson (Mellon Inst., Pittsburgh). Spectrochim. Acta 16, 6-11(1960).

Infrared and Raman spectra were obtained for $TiBr_4$. The infrared spectrum, which was not reported previously, was measured from 185 to 3000 cm^{-1}. The Raman spectrum agrees well with that given earlier by Delwaulle and Francois. The vibrational fundamentals for T_d symmetry are a_1 = 229.5, e = 74.0, f_2 = 90.5, and 383 cm^{-1}. These agree with Delwaulle and Francois earlier assignments. Calculated thermodynamic properties and force constants are included. (auth)

1419

INFRARED SPECTRA OF INORGANIC IONS IN THE CESIUM BROMIDE REGION (700-300 cm^{-1}). Foil A. Miller (Mellon Inst., Pittsburgh), Gerald L. Carlson, Freeman F. Bentley, and Wade H. Jones. Spectrochim. Acta 16, 135-235(1960).

The infrared spectra from 300 to 880 cm^{-1} of 208 inorganic substances are reported. Nearly all are salts containing polyatomic ions. Spectral curves are presented for 140 of the compounds, and a list of characteristic frequencies is given for twenty ions. Among other matters discussed are the non-reproducibility of some of the spectra, and reasons for this; absorption due to the torsional oscillation of water molecules; and some vibrational assignments for MnO_4^- and CrO_4^{2-} (auth)

1420

ANNUAL REVIEW OF PHYSICAL CHEMISTRY. VOLUME 11. H. Eyring, C. J. Christensen, and H. S. Johnston, eds. Palo Alto, Calif., Annual Reviews, Inc., 1960. 592p.

Twenty-one papers of a review nature together with extensive bibliographies are presented on a variety of topics including thermodynamic properties of substances; solutions; gaseous reactions; radiation, colloid, solid, and surface chemistry; quantum theory of molecules; spectroscopy; transport; fused salts; chromatography; nuclear and electron resonance; combustion; and photosynthesis. Author and subject indexes are given for the contents. Separate abstracts have been prepared for two papers. (D.L.C.)

1421

THERMODYNAMIC PROPERTIES OF THE WATER–BORIC OXIDE AND WATER–LITHIUM OXIDE SYSTEMS BY MASS SPECTROMETRIC METHODS. W. A. Chupka, J. Berkowitz, and D. J. Meschi (Argonne National Lab., Ill.). p.19-22 of "Proceedings of the Propellant Thermodynamics and Handling Conference, 1959, Special Report 12, Ohio State University."

Heterogeneous equilibria involving (1) water vapor and lithium oxide and (2) water vapor and boric oxide were studied by mass spectrometric analysis of the equilibrium vapor phase. The reactions were carried out in a Knudsen cell containing a gas introduction tube. The major reactions, at the indicated temperatures and about 1-mm Hg water-vapor pressure, are as follows: $Li_2O_{(s)} + H_2O_{(g)} \rightarrow 2LiOH_{(g)}$, T = 1300°K, $\Delta H = 80 \pm 3$ kcal; $B_2O_{3(s)} + H_2O_{(g)} \rightarrow 2HBO_{2(g)}$, T = 1250°K, $\Delta H = 84.2 \pm 1.5$ kcal. In the first reaction the dimer $(LiOH)_2$ was present in amounts about one twentieth that of the monomer. In the second reaction both the trimer $(HBO_2)_3$ and H_3BO_3 were identified and found to be minor vapor-phase constituents of approximately equal concentration. The concentration of each was about one hundredth that of HBO_2. (auth)

Radiation Chemistry and Radiochemistry

1422 IDO-14344

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

PILOT PLANT DEVELOPMENT OF A PROCESS FOR SEPARATING BARIUM-140 FROM MTR FUEL. B. M. Legler, W. L. Chase, M. D. Martin, D. M. Paige, and F. K. Wrigley. Sept. 1, 1955. Decl. Aug. 15, 1960. 171p. Contract AT(10-1)-205. OTS.

Extensive full-scale pilot-plant studies, using unirradiated materials, of a precipitation process designed to separate 30,000 to 50,000 c quantities of high-purity B^{140} from a twenty-day-irradiated two-day-cooled MTR fuel assembly were conducted. Centrifugation was employed to effect liquid-solid separations. This process consists generally of fuel dissolution in five molar sodium hydroxide followed by centrifugation of dissolver slurry to remove aluminum; dissolution of caustic residue in dilute nitric acid followed by centrifugation to remove barium-containing solution from silica and insoluble particulates; precipitation of barium nitrate by solution concentration and concentrated nitric acid precipitant addition followed by centrifugation to remove uranium and fission products; double precipitation of barium chromate from aqueous crude product solution followed by centrifugation to remove strontium; metathesis to and final precipitation of barium nitrate followed by centrifugation to remove remaining product impurities; and product drying. Pilot plant operation employing inactive barium and simulated fission product spike to dissolver cake yielded barium recoveries of 70 to 90% and high product purity. The process indicates good reproducibility and operability with an overall operating time of approximately 16 hr. Waste uranium bearing solution is suitable for recovery of uranium in existing Idaho Chemical Processing Plant facilities. Unrecoverable uranium amounts to approximately 2% of that charged. (auth)

1423

RADIOCHEMICAL PRECIPITATION STUDIES OF RARE-EARTH OXALATES. Kenneth G. Broadhead and Howard H. Heady (Bureau of Mines, Reno, Nev.). Anal. Chem. 32, 1603-6(1960) Nov.

Radiochemical techniques are used to determine quantitatively the effect of temperature, digestion time, pH, rare-earth concentration, oxalic acid concentration, stirring, and the presence of other rare-earth ions on the oxalate precipitation of lanthanum, samarium, and yttrium. A Latin Square experimental design is used to evaluate some of the variables statistically. Precipitation losses range from near zero to about 7%, and mineral acid and rare-earth concentrations are the predominant factors affecting completeness of precipitation. Optimum conditions are given for precipitating rare-earth oxalates. (auth)

1424

CHEMICAL EFFECTS OF IONIZING RADIATION. 3. RADIATION CHEMISTRY OF HALOGEN- AND OXYGEN-CONTAINING COMPOUNDS. Arnim Henglein (Mellon Inst., Pittsburgh). Angew. Chem. 72, 603-11(1960). (In German)

Ionizing radiation produces in the presence of functional groups materials of lower and higher molecular weight through changes in the functional groups themselves or in the hydrocarbon portion. One part of the radiation reaction proceeds by thermalized free radicals and then by rapid, diffusion-controlled processes such as hot-radical and ion reactions. Mass spectrometric studies led to the discovery of long-lived activated complexes of ion-molecule complexes in alkyl halides and of negative-ion reactions. Several radiation reactions are of interest in preparative chemistry, e.g., the condensation of amines and hydroxy compounds to dimers or higher polymers; the synthesis of organic dichlorophosphines, trichlorosilanes, and dichloroarsines from mixtures of saturated and unsaturated hydrocarbons with inorganic polychlorides; and the synthesis of nitroso- compounds from organic liquids and nitrogen monoxide. (tr-auth)

1425

RADIATION CHEMISTRY. William H. Hamill (Univ. of Notre Dame, Ind.). Ann. Rev. Phys. Chem. 11, 87-106 (1960).

An extensive review of radiation chemistry is presented with the following topics: (1) reviews and books on radiation chemistry, (2) gases (electron impact and reactions), (3) water and aqueous solutions, (4) organic liquids, and (5) solids and polymers. A bibliography of 174 references is given. (D.L.C.)

1426

HIGH ENERGY REACTIONS OF ATOMIC HYDROGEN. Michael Henchman, David Urch, and Richard Wolfgang (Yale Univ., New Haven). Can. J. Chem. 38, 1722-33 (1960) Oct.

The chemistry of hot hydrogen atoms was studied using tritium of high kinetic energy as produced by nuclear recoil. The possibilities and limitations of this technique are discussed using a collision theory for reactions of atoms having a very high initial energy. Using this theory and certain experimental data, it was concluded that hot hydrogen atoms react to combine with organic molecules at very high collision efficiency (of the order of approximately 0.2 to 0.4) in the energy range 3 to 10 ev. There was no indication that collisions at much higher energies led to combination. With most systems, e.g., alkanes, a wide variety of reactions was observed. The systematics of these hot reactions is discussed, and evidence on their detailed mechanism is presented. It appeared that most products were formed by a fast displacement of an atom or group by the hot hydrogen. There was no evidence for the formation of a common, internally equilibrated, collision complex that decays on a statistically determined basis to the various products. Instead the course of the reactions seemed largely governed by the direction and point of impact of the hot atom; thus sterochemical evidence indicated that axial approach of the hot hydrogen atom along the C—H bond axis led to abstraction whereas approach at large angles to this axis resulted in displacement without Walden inversion. In some cases sufficient excitation energy was introduced in the hot displacement process to cause further decomposition of the primary product. This model of high-energy reactions is compared with that of thermal reactions, and its general implications are briefly discussed. (auth)

1427

HOT ATOM REACTIONS AND RADIATION-INDUCED EFFECTS IN THE REACTIONS OF RECOIL TRITIUM WITH CYCLOPROPANE. J. K. Lee, Burdon Musgrave, and F. S. Rowland (Univ. of Kansas, Lawrence). Can. J. Chem. 38, 1756-68(1960) Oct.

Recoil $He^3(n,p)$ tritium atoms were reacted with cyclopropane in the gas phase under a variety of experimental conditions. The labeled hydrocarbon and molecular hydrogen products were separated by gas chromatography and assayed by gas proportional counting. The observed products showed a strong dependence upon irradiation dose. Cyclopropane was very inert toward reactions with hydrogen atoms and organic radicals, and the labeled olefinic products reacted preferentially, in effect as scavengers, with the reactive species from radiolysis of the parent molecule. Energetic tritium atoms were able to react with cyclopropane to give labeled cyclopropane as a product without causing isomerization or decomposition of the molecule. The relative yields of cyclopropane and propylene were dependent upon the average collisional deexcitation times, indicating that a fraction of the labeled cyclopropane molecules decompose in times of approximately 10^{-9} seconds. Cyclopropane, propylene, ethylene, hydrogen, and small amounts of allene and methylacetylene

were observed as "hot" products in the presence of gaseous free radical scavengers. Many additional compounds were found as the result of free radical and/or radiolysis reactions in the absence of scavengers. The "hot" reactions are explained in terms of the single-step interactions of high kinetic energy tritium atoms with the cyclopropane molecules. The energy for endothermic and high activation energy processes was obtained from the recoil energy. The kinetic energy of the recoil atom at reaction was estimated to be of the order of 130 kcal/mole for some of the observed labeled compounds. (auth)

1428

RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF ORGANIC COMPOUNDS. Jiřf Teplý (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Chem. listy 53, 1248-62(1959) Dec.

A concise review is given of the most important developments in the radiation chemistry of aqueous solutions of organic materials. Separate sections are devoted to the radiation chemistry of aliphatic hydrocarbons, alcohols, carbonyl compounds, sugars, acids, halogen derivatives, amines, sulfuric compounds, benzene and its derivatives, steroids and heterocyclic compounds, organic dyes, and the organic esters of phosphoric acid. 116 references, predominantly English, are included. (JPRS)

1429

PHOTOSENSITIZED OXIDATION OF PROPANE WITH X-RAYS. William H. Clingman, Jr. (American Oil Co., Texas City, Tex.). Ind. Eng. Chem. 52, 915-18(1960) Nov.

The photosensitized oxidation of propane with high energy radiation was investigated as a selective process for producing propyl alcohols and acetone. The reaction took place at room temperature over zinc oxide under the influence of γ radiation. Acetone, ethyl alcohol, n-propanol, and 2-propanol were the initial products formed; aldehydes and acids were absent. These initial products reacted further as irradiation continued. Propane conversion is a linear function of radiation dose after an initial line-out period. With at least one form of zinc oxide, pressure and temperature have little effect on conversion. Evidence is presented that the rate determining step is the conversion of chemisorbed oxygen to the active oxidizing agent during radiation-induced desorption of oxygen from zinc oxide. Electrical measurements were used to investigate this radiation-induced desorption. (auth)

1430

THE CROSS-LINKING AND CHAIN FRACTURE OF RUBBER BY HIGH-ENERGY RADIATION. P. Hayden (Atomic Energy Research Establishment, Wantage, Berks, Eng.). Intern. J. Appl. Radiation and Isotopes 8, 65-71(1960) July. (In English)

Quantitative analysis of the solubility data of irradiated rubber, using the method adopted by Charlesby and Pinner, has been applied to the study of the cross-linking reaction. The rate of cross-linking is directly proportional to the radiation intensity and corresponds to a G-value of 0.83 at 25°C. The activation energy of the cross-linking reaction is 0.76 and 0.26 kcal above and below the glass transition temperature, respectively. The ratio of dislinking to cross-linking is 0.05. It is largely independent of radiation intensity and temperature. Radiation induces the formation of some trans-vinylene unsaturation, believed to arise from a double bond shift. A considerable amount of terminal unsaturation, believed to arise as a result of dislinking, is also formed. (auth)

1431

A POSITRON COW. G. I. Gleason (Abbott Labs., Oak Ridge, Tenn.). Intern. J. Appl. Radiation and Isotopes 8, 90-4(1960) July. (In English)

Short-lived Ga^{68} can be prepared from its long-lived parent, Ge^{68}, thus providing a convenient source of positron-emitting activity for medical or other applications. Solvent extraction is used for the rapid separation of the gallium daughter and a method for the production of the germanium parent is given. A review of the usable positron emitters serves to underscore the advantages of the $Ge-Ga^{68}$ system. (auth)

1432

PREPARATION OF CARRIER-FREE Cr^{51}. D. de Soete, J. Hoste, and G. Leliaert (Univ. of Ghent). Intern. J. Appl. Radiation and Isotopes 8, 134-6(1960) July. (In English)

A method was devised to prepare carrier-free Cr^{51} from deuteron irradiated vanadium targets. The chromium is distilled quantitatively as CrO_2Cl_2 after removal of arsenic, antimony, and tin, which can be present as impurities if the target is soldered to the target holder. The main element vanadium and traces of iron do not distill. The thick target yields, determined by a γ-spectrometry of the 0.323 Mev γ only, were found to be 4.4 μC μA.h and 10 μC/μA.h for deuteron energies of 11 Mev and 25 Mev respectively. (auth)

1433

EFFECTS OF LIGHT AND IONIZING RADIATION ON THE AUTO-OXIDATION OF CYSTEINE AND THE REACTION BETWEEN CYSTEINE AND 3,4-BENZOPYRENE. R. Koch and J. Frănz (Universität, Freiburg i. B.). Intern. J. Radiation Biol. 2, 383-92(1960) Oct. (In German)

To find whether or not organic photo- or radiation-catalysts can also become effective in an aqueous medium in accordance with Schenk's theory, a simple model was chosen. The oxidation of cysteine alone was observed in darkness, in UV, and under x irradiation; and of cysteine mixed with a suspension of 3,4-benzopyrene under the same conditions. Undoubtedly UV accelerates the oxidation of cysteine both alone and in the presence of the cyclic hydrocarbon. When x-irradiated the increase of cysteine oxidation can only become effective after a total dose of approximately 4000 r. When a cysteine solution containing a suspension of 3,4-benzopyrene is irradiated, the increase of oxidation in the darkness is clearly reduced. For this reducing-effect a dose of 600 r is sufficient. (auth)

1434

THE EFFECT OF AMINE SCAVENGERS ON PRODUCTS OF NEUTRON IRRADIATION OF ORGANIC HALIDES. I. G. Campbell (Inst. of Nuclear Research, Warsaw). J. Inorg. & Nuclear Chem. 15, 37-45(1960) Sept. (In English)

The mechanism of the effect of primary amines on retention in neutron irradiated organic halides was investigated. The evidence indicates that amines may act as radical scavengers. (auth)

1435

SOME PROPERTIES OF THE UNSTABLE INTERMEDIATE PRODUCED BY ISOMERIC TRANSITION OR (n,γ) REACTION IN BROMATES. I. G. Campbell (Inst. of Nuclear Research, Warsaw). J. Inorg. & Nuclear Chem. 15, 46-9 (1960) Sept. (In English)

Some properties of the unstable intermediate, probably BrO_3^{+2}, formed in (n,γ) reaction and isomeric transition in bromates were studied. The most probable reaction whereby the Br^* of such a fragment comes to be present as bromate is a hydration reaction insensitive to pH and, in the case of isomeric transition, insensitive to ionic strength. (auth)

1436

FREE RADICAL LIFETIMES IN RADIATION-INDUCED REACTIONS. THE ADDITION OF n-BUTYL MERCAPTAN TO OCTENE-1. William H. Clingman, Jr. (American Oil Co., Texas City, Tex.). J. Phys. Chem. 64, 1355-9(1960) Oct.

The free radical lifetime in the radiation-initiated reaction of n-butyl mercaptan and octene-1 was measured by a modification of the rotating sector technique. The reactants were sealed in a circular glass tube, which was fastened to a plastic wheel and rotated past a β radiation source. The radical lifetime could be determined from the variation of the yield with the rate of rotation of the wheel. The inhomogeneous absorption of the β radiation in the sample and possible effects of reactant diffusion during an experiment were considered in the quantitative interpretation of the data. The experimental value of the lifetime was used to estimate the individual rate constants of the chain reaction. From a comparison of the results with data for similar systems, it was concluded that only part of the radicals produced by the radiation initiate the mercaptan-olefin reaction. (auth)

1437

THE RADIOLYSIS OF DEUTERATED BIPHENYLS: MECHANISM OF HYDROGEN FORMATION. J. G. Burr and J. M. Scarborough (Atomics International, Canoga Park, Calif.). J. Phys. Chem. 64, 1367-74(1960) Oct.

Certain general characteristics of the radiation chemistry of aromatic hydrocarbons are summarized. The values of G(hydrogen), G(H), G(D), and the $H_2/HD/D_2$ ratios observed in the radiolysis with Co^{60} γ rays of biphenyl, biphenyl-4,4′-d_2, biphenyl-2,2′,6,6′-d_4, biphenyl-3,3′,5,5′-d_4, biphenyl-2,2′,4,4′,6,6′-d_6, biphenyl-2,2′,3,3′,5,5′,6,6′-d_8, and biphenyl-d_{10} are reported. The formation of radiolytic hydrogen is insensitive to any difference between the ortho, meta, and para positions of biphenyl (although it is sensitive to the 1.3 kcal./mole difference between C–H and C–D bonds) since the specific rates of H and D formation are insensitive to the location of deuterium on the hydrocarbon, and the total hydrogen yield is a linear function of the deuterium content of the biphenyl. The isotope effect in the formation of radiolytic hydrogen and deuterium (3.00) was observed to be different from that observed in the loss of one or two hydrogen atoms (or deuterium atoms) in the dissociation of the corresponding molecule-ion in the mass spectrometer (1.8). It is shown that this same isotope effect of 3.00 and simple statistical considerations can be used successfully to account for the H_2, HD, and D_2 ratios in the hydrogen from individual hydrocarbons. However, the H_2, HD, and D_2 content of the hydrogen from a mixture of biphenyl and biphenyl-d_{10} cannot be so described; and was observed to be unequilibrated. It is suggested from this that at least two processes are involved in the formation of radiolytic hydrogen from biphenyl. (auth)

1438

THE RADIOLYSIS OF AQUEOUS CALCIUM BENZOATE AND BENZOIC ACID SOLUTIONS. William A. Armstrong, Barbara A. Black, and Douglas W. Grant (Defence Research Board, Ottawa). J. Phys. Chem. 64, 1415-19(1960) Oct.

Fluorometric techniques were utilized to determine the yields of o-, m-, p-hydroxybenzoic acids and phenol formed and the yield of benzoate ion (G_{-B_z}) consumed in irradiated aerated aqueous calcium benzoate solutions. For 6×10^{-4}M solutions irradiated with Co^{60} γ rays, $G_{ortho} = 0.67$, $G_{meta} = 0.37$ and $G_{para} = 0.37$. Similar o:m:p ratios but slightly lower absolute yields were obtained at higher dose rates using 3 Mev x rays. For Co^{60} γ-irradiated calcium benzoate solutions G_{-B_z} was 2.05 (10^{-4} M); and G_{PhOH} was 0.05 (10^{-5} M). Initial hydrogen peroxide yields in Co^{60} γ-irradiated solutions were 2.55, 2.35, and 2.30 in 5×10^{-4}M calcium benzoate, 10^{-2}M benzoic acid, and 5×10^{-4}M calcium benzoate solutions, respectively. Phenyl benzoate, biphenyl, and 4-biphenylcarboxylic acid, if formed, were formed in small yield. For 10^{-3}M benzoic acid solutions (in 0.36M H_2SO_4) irradiated with 300 kev peak x rays, G_{CO_2} was 0.68(aerated), 0.4(degassed); and G_{H_2} was 0.6(degassed). The results are discussed in terms of the free radical theory of radiation chemistry. (auth)

1439

RADIATION CHEMISTRY OF CYCLOPENTANE-CYCLOHEXANE MIXTURES. G. A. Muccini and Robert Schuler (Mellon Inst., Pittsburgh). J. Phys. Chem. 64, 1436-8(1960) Oct.

Radiolysis of mixtures of cyclopentane and cyclohexane with γ rays at 70,000 rads/hr results in a greater yield of products derived from cyclopentane than would be expected from the fraction of this component in the system. This effect is attributed to a change in the identity of the intermediate radicals as a result of preferential abstraction of hydrogen from the cyclopentane. Studies of the primary radical yields by iodine scavenging methods and of the effect of intensity on the products from the mixed hydrocarbons confirm this explanation. (auth)

1440

THE G_{OH} IN THE Co-60 RADIOLYSIS OF AQUEOUS $NaNO_3$ SOLUTIONS. H. A. Mahlman (Oak Ridge National Lab., Tenn.). J. Phys. Chem. 64, 1598(1960) Oct.

The reduction of Ce^{4+} in an 0.8N H_2SO_4 solution was determined to be equal to $2G(H_2O_2) + G_H - G_{OH} + [0.45 - G(H_2)]$. Solutions of 0.004M Ce^{4+} and 0.8N H_2SO_4 in various concentrations of $NaNO_3$ were irradiated both with and without the addition of 10^{-3}M Tl^+. When the thallous ion was present, the cerous yield became $2G(H_2O_2) + G_H + G_{OH} + [0.45 - G(H_2)]$. The calculated G_{OH} was constant over the entire $NaNO_3$ concentration from 0.1 to 5.0M and equal to 2.86. (M.C.G.)

1441

ELECTRON-COLLISION CONDITIONED REARRANGEMENT OF CARBON SKELETONS IN SOME C_7H_8 ISOMERS. V. Hanus and Z. Dolejšek (Inst. for Physical Chemistry, Academy of Sciences, Prague). Kernenergie 3, 836-9(1960) Sept. (In German)

Electron impact ionization studied at various mass spectrometric conditions led to the proposal that not only cycloheptatriene and toluene form tropylium ions but also other C_7H_8 isomers. The secondary products result by decomposition of the excited tropylium ion or by other reactions. In 1-ethinylcyclopentene both reactions are verified by labeling with deuterium. (auth)

1442

THE MECHANISM OF ACCELERATION DURING RADIATION-INDUCED COPOLYMERIZATION. János Dobó and Ágnes Somogyi (Organic Chemical Industry and Synthetic Materials Industry Research Inst., Budapest). Magyar Kém. Folyóirat 65, 383-6(1959) Oct.

Tables and graphs are presented showing the results of experiments on the x-radiation-induced graft copolymerization of polyethylene with methyl methacrylate and styrol. The considerable difference in polymerization rates in favor of graft copolymerization (6400%) over homopolymerization (3%) confirms the conclusion that graft copolymerization forms free radicals not only on the original polymer

but also on the grafted side chains, causing further grafts. This results in a special graft autoacceleration that differs from the well-known autoacceleration (gel effect) in polymerization. The two autoaccelerations can be combined. Graft autoacceleration is useful in determining the ratio of the G values of the original and grafted polymers. The contention that the efficiency of graft copolymerization can be accurately determined from the G values of the given polymer and grafted monomer is not generally applicable; such factors as the radioactivity of the grafted side chains, shielding, and the expansion of the polymer in the monomer must also be taken into consideration. (JPRS)

1443

INVESTIGATION OF THE EFFECTS OF X-RAYS ON DILUTE AQUEOUS SOLUTIONS OF METHYLENE BLUE. Imre Safarik (Central Chemical Research Inst., Hungarian Academy of Sciences, Budapest). Magyar Kém. Folyóirat 65, 400-3(1959) Oct.

Experiments to determine the correlation between the effects of x radiation on dilute aqueous solutions of methylene blue and pH values (0 to 3.0) are described. At a given dose the amount of decomposed methylene blue drops in proportion to the decrease in pH. Additives recommended by Orekhov and Chernova (D-glucose and $Fe_2(SO_4)_3$) were used to study separately the reversible reduction and the irreversible oxidation of methylene blue in the absence of oxygen. The decrease of H^+ concentration favors the reduction and retards the oxidation. The results show good agreement with Dainton's theory on oxidation-reduction processes and with Hart's results on the number of H^+ and OH^- radicals formed. (JPRS)

1444

EXAMINATION OF γ-IRRADIATED BENZENE FOR OPTICAL ACTIVITY. Leonard Spialter and Jean H. Futrell (Aeronautical Research Labs., Wright-Patterson AFB, Ohio). Nature 188, 225-6(1960) Oct. 15.

It was reported that irradiation of benzene with γ rays at 3×10^5 r/hr resulted in a rotation of the polarization plane, indicating the occurrence of asymmetric molecules not possessing a center or plane of symmetry. Specially purified benzene was irradiated with a 20,000-c Co^{60} source at 6.0×10^7 μg/g/hr to a total dose of 10^7 r. Although the irradiation produced some significant color changes, no evidence of asymmetric molecules was found. (B.O.G.)

1445

EFFECT OF X-RAYS ON CYTOSINE IN AERATED AQUEOUS SOLUTION. B. Ekert and R. Monier (Foundation Curie et Laboratoire Pasteur de l'Institut du Radium, Paris). Nature 188, 309-10(1960) Oct. 22.

Ion-exchange chromatography of cytosine solutions irradiated with x rays under air or oxygen was found to separate three degradation products, A, B, and C, which were not detected when the solutions were irradiated under nitrogen. Tests indicated that C was identical with 6-amino-isobarbituric acid. When A was heated to boiling in 2N HCl, it had the same ultraviolet spectrum as isobarbituric acid. The remaining compound, B, was thought to be an intermediate product in the formation of A and C. (M.C.G.)

1446

THE DETERMINATION OF THE G-VALUE OF γ-RADIATION-INDUCED REACTIONS BY POLAROGRAPHIC ELECTROLYSIS AT CONSTANT POTENTIAL. Zbigniew Paweł Zagórski (Inst. of Nuclear Research, Warsaw). Nukleonika 5, 253-60(1960). (In English)

Experimental details and an equation are given for the polarographic determination of G-value, which defines the yield of reactions in radiation chemistry. It is shown that following the reaction by polarographic means during irradiation gives much information not otherwise easily obtained. (auth)

1447

PATHS OF MOLECULAR EXCITATION. Michael Kasha (Florida State Univ., Tallahassee and Harvard Univ., Cambridge, Mass.). Radiation Research, Suppl. 2, 243-75 (1960).

The intramolecular pathways for electronic excitation are described in terms of orbital type of excitation, and multiplicity of the states involved, with the consideration of the kinetic and quantal requirements on the transitions between excited states. For most molecules studied, it is appropriate to classify the lower energy-excited states into two broad groups, those involving only π-electron excitation (π, π* states), and those involving lone-pair or n-electron (nonbonding) excitation to π-antibonding orbitals (n, π* states). When the oscillator strengths are considered, and the nature of spin-orbital effects is taken into account, the predominance of singlet-singlet luminescence for molecules with lowest (π, π*) singlet excited states, and the uniqueness of the triplet-singlet luminescence for molecules with lowest (n, π*) singlet excited states can be understood. The application to photochemical and radiation-chemical studies are discussed, with an indication of the need for such studies on biologically important molecules. 39 references. (auth)

1448

DECAY TIMES OF HIGH-ENERGY INDUCED LUMINESCENCE. Milton Burton, Amal Ghosh, and Juan Yguerabide (Univ. of Notre Dame, Ind.). Radiation Research, Suppl. 2, 462-70(1960).

A repetitive time-selection technique was used to measure decay curves of luminescence in a number of benzene and cyclohexane solutions as well as in a plastic scintillator. In some cases, these decay curves give over-all values of the decay time, τ, which may be resolved into two parts: τ_1, which may be assigned to excited solvent, and τ_2, which might be assigned to excited scintillator. New values obtained are as follows: $\tau_1 \leqq 0.3 \times 10^{-9}$ sec for excited cyclohexane in aerated solution; $\tau_2 = 2.2 \times 10^{-9}$ sec in solutions of p-terphenyl in aerated cyclohexane or benzene and increases, when the solutions are deaerated, to $\geqq 2.8 \times 10^{-9}$ sec in cyclohexane and 2.5×10^{-9} sec in benzene. For excited p-terphenyl in dimethylstyrene polymer, it seems that τ is 2.8×10^{-9} sec. In PPO solutions in aerated benzene, τ_2 is 2.6×10^{-9} sec. Questions are raised regarding the mechanism of energy transfer from cyclohexane (excited or ionized) and also regarding the propriety of assignment of τ_2 to the excited state of the solute. (auth)

1449

ENERGY TRANSFER IN NONAROMATIC CHEMICAL SYSTEMS. A. O. Allen (Brookhaven National Lab., Upton, N. Y.). Radiation Research, Suppl. 2, 471-9(1960).

Results are discussed from a study of the decomposition of an aliphatic organic compound, pentane, when irradiated while adsorbed on a mineral support of high specific surface such as silica gel. The role of nonaromatic chemical systems in energy transfer, reaction mechanisms involved in primary radiation effects in biological systems, the radiation chemistry of aliphatic compounds and systems of materials mixed together, and mechanisms of energy transfer are also discussed. (C.H.)

1450

DETECTION AND IDENTIFICATION OF LONG-LIVED

RADICALS. Karl H. Hausser (Max-Planck-Institut, Heidelberg, Ger.). Radiation Research, Suppl. 2, 480-96(1960).

The most sensitive and specific method of detecting free radicals is that of electron spin resonance (ESR). Some basic theory is given as far as it is considered necessary to an understanding of the general principles. The experimental methods employed are briefly surveyed, and include some considerations on quantitative measurements and ultimate sensitivity. The hyperfine structure (HFS) which results from the interaction between the unpaired electron and the magnetic nuclei of the radicals is treated in detail. Because of the close relation between the structure of one particular radical and its HFS pattern, it is possible to identify and to distinguish between different radicals. This is illustrated by some examples. The importance of obtaining the best possible resolution of the individual HFS lines is stressed. An example of an electron donor-acceptor equilibrium involving radicals could be of interest in connection with mechanisms of electron transfer. Further examples deal with radicals produced by UV and high-energy radiation. Finally, a more-recent biological application is given which seems to imply consequences of considerable interest. (auth)

1451

SURVEY OF THE ACTION OF IONIZING RADIATIONS IN AQUEOUS SYSTEMS, AND SOME CONSIDERATIONS OF ENERGY TRANSFER. Walter M. Dale (Medical Research Council, Manchester, Eng. and Christie Hospital, Manchester, Eng.). Radiation Research, Suppl. 2, 578-85(1960).

Results are reviewed from a number of studies on effects of radiation in aqueous systems. Mechanisms of energy transfer are considered. Results are reported from studies of the radiation chemistry of thiourea. 30 references. (C.H.)

1452

CHEMICAL EFFECTS OF IONIZING RADIATION ON PURE ORGANIC COMPOUNDS. B. M. Tolbert and Marie H. Krinks (Univ. of Colorado, Boulder). Radiation Research, Suppl. 2, 586-607(1960).

Data on radiation effects in organic compounds are reviewed and results are discussed briefly. The data presented are restricted to permanent chemical changes produced by ionizing radiation in pure organic compounds. Only changes resulting in loss or modification of the starting molecule or in the formation of new stable molecules are considered. Data are tabulated from studies on over 190 different compounds, and many of these substances were investigated in different physical states and with different radiation. All results are expressed as G-values, where a G-value is defined as the number of molecules, radicals, or ions produced for 100 ev of absorbed ionizing radiation. G(–M)-values represent the number of starting molecules permanently changed per 100 ev of absorbed ionizing radiation. 100 references. (C.H.)

1453

RADIATION EFFECTS IN GELS. L. H. Gevantman (U. S. Naval Radiological Defense Lab., San Francisco). Radiation Research, Suppl. 2, 608-26(1960).

Results are reported from a number of studies of radiation effects in gels. Topics discussed include the use of gel systems as radiation dosimeters, and the nature of the gel effect. 34 references. (C.H.)

1454

RADIOCHEMISCHE TRENNUNGEN IM ZUSAMMENHANG MIT KERNREAKTIONEN. (Radiochemical Separations in Connection with Nuclear Reactions). Amr El-Sioufi. Thesis, Zurich, Eidgenössische Technische Hochschule, 1959. 64p.

In relation with investigations of photon-induced particle emission with a 32-Mev betatron, as well as with measurements of angular correlations and β-spectrometric analysis, radiochemical separation methods were developed for the following elements: Zn/Cu, Sb/Sn, Mo/Nb, Ta/Lu, Tl/Au, Ta/W, Pb/Bi, Fe/Mn, Cu/Co, and Re/Ta. It was proved that carrier-free methods and methods having a minimum carrier give the best results. The yield of each separation was plotted as a function of the carrier quantity to discover the best one. The cross-section-photon-energy relation was investigated for the reactions: $Zn^{68}(\gamma,p)Cu^{67}$, $Zn^{66}(\gamma,pn)Cu^{64}$, $Tl^{205}(\gamma,\alpha)Au^{201}$, and $Tl^{205}(\gamma,n\alpha)Au^{200}$. The integrated cross sections were determined for: $Zn^{68}(\gamma,p)Cu^{67}$, $Zn^{66}(\gamma,pn)Cu^{64}$, $Mo^{92}(\gamma,pn)Nb^{90}$, $Sb^{123}(\gamma,pn)Sn^{121}$, $Ta^{181}(\gamma,\alpha)Lu^{177}$, $Tl^{205}(\gamma,\alpha)Au^{201}$, and $Tl^{205}(\gamma,n\alpha)Au^{200}$. In contrast to earlier literature data, the reactions $Zn^{68}(\gamma,p)Cu^{67}$ and $Zn^{66}(\gamma,pn)Cu^{64}$ did not show extremely large cross sections. (auth)

Raw Materials and Feed Materials

1455 ORNL-2797

Oak Ridge National Lab., Tenn.

FLUOROX PROCESS: PRODUCTION OF UF_6 IN A FLUIDIZED BED REACTOR. C. D. Scott, J. B. Adams, and J. C. Bresee. Oct. 27, 1960. 59p. Contract W-7405-eng-26. OTS.

The engineering feasibility of producing UF_6 from UF_4 by oxidation with dry air or oxygen in a continuous 4-in.-diameter fluidized-bed reactor was demonstrated in eight runs at bed temperatures of 700 to 850°C. With refined UF_4 feed and either dry oxygen or air as the oxidizing and fluidizing gas, up to 90% of the theoretical amount of UF_6 formed was collected in cold traps, and the remainder was accounted for by side reactions. With crude UF_4 feed, corrosion of the Inconel reactor was excessive. A method of preparing feed for the reactor by compacting fine UF_4 to +20 mesh and grinding the compact to –20 +150 mesh was developed. A cost estimate was made for an integrated Fluorox plant, including feed preparation, oxidation, and provision for recycle of the by-product UO_2F_2, with a capacity equivalent to 5000 tons of U_3O_8 per year. (auth)

1456

THE EFFECT OF CONCENTRATION OF THE URANIUM OXIDE SUSPENSIONS ON THE VOLUMETRIC STEAM CONTENT IN CONDITIONS OF SPARGING. M. A. Styrikovich, G. G. Bartolomeĭ, Ya. G. Vinokur, and V. A. Kolokol'tsev (Inst. of Power Engineering, Academy of Sciences, USSR). Teploenergetika 7, No. 9, 19-22(1960) Sept. (In Russian)

The effects of suspension concentration on the volumetric steam content in sparging are investigated. The volumetric steam content of UO_3 and U_3O_8 (16 to 20%) differs very little from the vapor-containing condensate. With an increase in steam velocity, the difference in the steam contents of suspension and condensate is still further reduced. At a steam velocity of 0.7 to 0.9 m/sec the difference in the steam contents of condensate and suspension does not exceed 3 to 5%. (R.V.J.)

1457

A METHOD OF PREPARING FLUORIDE-FREE URANIUM DIOXIDE. (to Mallinckrodt Chemical Works). British Patent 850,957. Oct. 12, 1960.

Fluoride-free UO_2 with less than 100 ppm fluoride may be prepared from fluoride-containing ammonium diuranate

without prior purification by thermally decomposing the diuranate at 400 to 850°C in a stream of steam and hydrogen in a closed reactor made of a nickel alloy and continuing the heating until the U_3O_8 is reduced to UO_2. The fluorides are volatilized as HF and NH_4F during the thermal decomposition, and hydrogen in the atmosphere is necessary to prevent corrosion of the nickel alloy and subsequent contamination of the UO_2 with nickel oxides. The volume proportion of hydrogen to steam is preferably 1 to 10, though hydrogen may be supplied in the form of NH_3, which decomposes. With 850°C as the operating temperature, the thermal decomposition and reduction are complete in 3 and 2 hr, respectively. Ammonium diuranate prepared from NH_3 and UF_6 can be converted into UO_2 in this way without prior washing. This is an advantage because UO_2 from unwashed diuranate is more dense than UO_2 from thoroughly washed diuranate. Six examples of this method are given. (D.L.C.)

Separation Processes

1458 DP-491

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

REPROCESSING OF POWER REACTOR FUELS. Tenth Quarterly Progress Report [for] January 1, 1960 to April 1, 1960. E. S. Occhipinti, comp. Oct. 1960. 16p. Contract AT(07-2)-1. OTS.

Electrolytic dissolution of unirradiated Fermi core elements and of Zircaloy-2 was successfully demonstrated on a laboratory scale. Tantalum and niobium are adequate as materials of construction for the inert anode basket of an electrolytic dissolver in a field of 10^7 rep/hr. The corrosion of 304L and 309SCb in boiling HNO_3 is increased by the presence of dissolved stainless steel, which promotes intergranular attack of these metals. Corrosion tests of both welded and wrought 309SCb indicated that a solution of 0.075M HF and 0.05 to 1M HNO_3 offers advantages over either the 0.075M HF or the 0.075M HF – 3.0M HNO_3 solutions previously proposed for the chemical dissolution of Fermi core elements. Unirradiated Zr–low U alloy was dissolved in 1M HNO_3 by intermittent addition of HF at such a rate as to obtain an average penetration rate of 4.5 mils per hour. The average composition of the off-gas was 8% H_2, 18% N_2, 50% NO, 23% N_2O, and 1% miscellaneous trace gases. (For preceding period see DP-479.) (auth)

1459 HW-49574

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

EXAMINATION OF CORROSION TEST COUPONS IN PUREX 101 WASTE STORAGE TANKS–RM-147. D. H. Parks. Apr. 8, 1957. 19p. Contract AT(45-1)-1350. OTS.

An investigation was conducted to determine the effects of radioactive waste vapor on the corrosion resistance of primary and weld metal coupons of SAE 1020, Corten, Mayari-R, and Carilloy T-1 steels in stressed and unstressed conditions. (J.R.D.)

1460 CEA-tr-R-922

METHODE D'EXTRACTION DU ^{233}Pa. (Method of Extraction of Pa^{233}). I. E. Starik and L. D. Sheĭdina. Translated into French from Radiokhimiya 1, 270-2(1959). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 5273.

1461

THE ION EXCHANGE PROPERTIES OF SILICA GEL. II. SEPARATION OF PLUTONIUM AND FISSION PRODUCTS FROM IRRADIATED URANIUM. Sten Ahrland Ingmar Grenthe, and Bertil Norén (Univ. of Lund, Sweden). Acta Chem. Scand. 14, 1077-90(1960). (In English)

A procedure, based on selective sorption on silica gel, was worked out for the separation of plutonium and fission products from uranium which was irradiated with thermal neutrons. (auth)

1462

SOLVENT EXTRACTION OF ^{152,154}Eu AND ^{241}Am BY Di-n-BUTYL PHOSPHATE (DBP) IN DIFFERENT ORGANIC SOLVENTS. David Dyrssen and Liem Djiet Hay (Royal Inst. of Tech., Stockholm). Acta Chem. Scand. 14, 1100-11 (1960). (In English)

The distributions of Am^{241} and $Eu^{152,154}$ between aqueous nitric acid and solutions of di-n-butyl phosphate (=HA) were studied in seven organic solvents. The data indicated that in five systems, M is extracted into the organic phase predominately as $MA_3(HA)_3$. The following values were found for log K for the reaction M^{3+} (aq) + 3 A^-(aq) + 3 HA(aq) ⇌ $MA_3(HA)_3$(org): in n-hexane 13.66 (Eu), 12.38 (Am); in CCl_4 16.80 (Eu), 15.33 (Am); in $CHCl_3$ 19.33 (Eu), 17.98 (Am); in iso-propyl ether 14.94 (Eu), 13.72 (Am); in hexone 15.22 (Eu), 14.25 (Am); in hexol 14.15 (Eu), 14.02 (Am). In n-hexane deviations at [HA] > $10^{-1.8}$ M indicate the formation of other complexes, perhaps $MA_3(HA)_6$(org). In hexol, complexes with less HA appear for [HA] < 10^{-2} M. The data may be accounted for by the additional reaction M^{3+} + 3 A^- ⇌ MA_3(org), log K = 5.76 (Eu), 5.36 (Am). In tri-n-butyl phosphate (TBP), the reaction M^{+3} + 3NO_3^- + 3TBP (org) ⇌ $M(NO_3)_3(TBP)_3$(org) predominates for [HA] < 10^{-3} M; for [HA] > 10^{-4} M, the data indicate M^{3+} + 3 A^- ⇌ MA_3 (org), log K = 7.49 (Eu), 6.98 (Am). Parallels are drawn between the effect of the solvent on metal extraction equilibria and on the dimerization and distribution of HA (DBP) itself. For practical separation of europium and americium, n-hexane, CCl_4, and $CHCl_3$ are the best of the solvents studied; for given concentrations of HA and H^+, n-hexane and CCl_4 give the highest distribution ratio. (auth)

1463

STUDY ON THE TREATMENT BY ION EXCHANGE OF DISSOLUTION AND ACID LEACHING OF SPANISH MINERALS OF URANIUM. PART I. INTRODUCTION AND STUDY OF THE PHASE LOADING. B. López Pérez, A. Uriarte Hueda, M. Perarnau, and L. G. Jodra (Junta de Energia Nuclear, Madrid). Anales real soc. espãn. fís. y quím. (Madrid), Ser. B 56, 637-60(1960) June. (In Spanish)

Tests were carried out in laboratory scale operation in order to determine the influence of the contact time over the absorption of uranium and competitive ions on a strongly basic anion exchange resin in the nitrate or chloride form. Nitrate and chloride solutions were used in the elution steps and their behavior was compared. The possibility of mechanical and chemical damage to the resin due to erosion and poisoning was checked. A brief description is included of a pilot plant developed according to the data obtained in the preliminary laboratory scale. (auth)

1464

LIQUID-LIQUID EXTRACTION BETWEEN ROTATING CONCENTRIC CYLINDERS. M. W. Davis, Jr. and E. J. Weber (E. I. du Pont de Nemours & Co., Aiken, S. C.). Ind. Eng. Chem. 52, 929-34(1960) Nov.

Laboratory solvent extraction apparatus was required for studying the effect of stage residence time on the extraction behavior of fission products. To attain residence times of 5 to 10 sec per stage, extraction was carried out in the annulus between rotating concentric cylinders. Correlations of the amount of holdup of the dispersed phase,

the height equivalent to theoretical stage (HETS) values, and the residence time per theoretical stage were obtained as a function of the column variables. Residence times per theoretical stage as low as 5 to 10 sec were obtained for the dispersed phase. Since HETS values as low as 6 to 8 cm were obtained for the system used, only a relatively short column is required to give the multiple stage effect required to simulate larger solvent extraction equipment. (auth)

1465

ION EXCHANGE EQUILIBRIA OF URANYL SULFATE ION WITH CHLORIDE–SULFATE OR NITRATE–SULFATE MIXED FORM OF STRONGLY BASIC ANION RESINS. Takeo Yano, Takeshi Kataoka, and Teruyuki Nango (Univ. of Osaka). J. Atomic Energy Soc. Japan 2, 511-17(1960) Sept. (In Japanese)

Since eluting solutions used for the removal and refining of uranium are recycled, the resins absorb not only sulfate ion but also chloride ion or nitrate ion. The influence of sulfate ion and chloride ion or nitrate ion on strongly basic anion resins was studied. The results obtained are as follows: (1) the equilibrium curves showed an S shape in the range of low values of SO_4/UO_2 and an upward convex shape in high values of SO_4/UO_2. The equilibrium curves were described by an equation in the range $SO_4/UO_2 > 87$; (2) an optimum operational condition of the removal and refining of uranium in the ion exchange column was found as follows: pH = 3.0 ~4.5, SO_4^{2-} concn. (as SO_4/UO_2 mole ratio) >39 and UO_2SO_4 concn. = 2.0 ~4.0 g/l; and (3) the characteristic values of $Cl-SO_4$ mixed ion and NO_3-SO_4 mixed ion forms of the resins could be evaluated by equations given in the text. (auth)

1466

ANION EXCHANGE STUDIES. XXX. A NUMBER OF ELEMENTS IN ETHYLENEDIAMINETETRAACETIC ACID SOLUTIONS. F. Nelson, R. A. Day, Jr., and K. A. Kraus (Oak Ridge National Lab., Tenn.). J. Inorg. & Nuclear Chem. 15, 140-50(1960) Sept. (In English)

Adsorbabilities of a number of metals (Be, Ca, Sr, Ba, Ra, Sc, V, Cr, Mn, Co, Ni, and Zn) in EDTA solutions were studied as a function of EDTA concentration, supporting electrolyte concentration (NH_4Cl), and pH. Applicability of the results to separations is discussed and illustrations of several separations are given. Adsorbability of EDTA by the chloride form of the exchanger was determined as a function of loading. The selectivity of the exchanger for EDTA is sufficiently low to permit separations in EDTA solutions with the resin remaining substantially in the chloride form. From measurement of distribution coefficients of metals as a function of EDTA and chloride concentration, the charges of a number of EDTA complexes were verified. Adsorbabilities as a function of pH at constant EDTA and supporting electrolyte concentrations were consistent with published constants for metal–EDTA equilibria. The stability constant for the EDTA complex of Ra(II) was estimated from the anion exchange data to be $10^{7.4}$. (auth)

1467

SEPARATION OF TRANS-CURIUM ELEMENTS FROM LARGE QUANTITIES OF CURIUM, BY LIQUID-LIQUID EXTRACTION. N. M. Isaac, J. W. Wilkins, and P. R. Fields (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem. 15, 151-7(1960) Sept. (In English)

A solvent extraction procedure, using 100% normal tributyl phosphate and 12 M HCl for the separation of trans-curium elements from large quantities of curium, is described. The method, tested on pure curium and californium, was applied successfully to the separation of curium and californium from material resulting from the reprocessing of an irradiated plutonium sample. The following results were obtained for the reprocessing: 92 ± 11% of the californium was recovered containing 0.74 ± 0.05% of the original curium and 100 ± 7% of the curium was recovered containing an undetectable amount of the original californium. (auth)

1468

SYNERGIC EFFECTS IN THE SOLVENT EXTRACTION OF THE ACTINIDES. I. URANIUM(VI). H. Irving and D. N. Edgington (Inorganic Chemistry Lab., Oxford). J. Inorg. & Nuclear Chem. 15, 158-70(1960) Sept. (In English)

By using U^{233}, the solvent extraction of uranium(VI) from nitric acid into mixtures of 1,1,1-trifluoro-3-2'-thenoylacetone (TTA) and tri-n-butyl phosphate (TBP) or tri-n-butyl phosphine oxide (TBPO) in cyclohexane was studied. The extraction coefficient was found to be greater for such mixtures than for either component alone, the maximum enhancement in extraction being of the order of 10^3 and 10^4, respectively. The formulas of the extracted species were shown to be $UO_2X_2 \cdot TBP$ and $UO_2X_2 \cdot 3TBPO$ (HX = TTA), and their mixed equilibrium constants were calculated. The general problem of synergism in the solvent extraction of metal complexes was discussed. (auth)

1469

ION EXCHANGE IN SOLVENT MIXTURES. III. ON THE DISTRIBUTION OF THORIUM CHLORIDES BETWEEN THEIR ALCOHOLIC HYDROCHLORIC ACID SOLUTIONS AND STRONGLY BASIC ANION EXCHANGERS. J. Korkisch and F. Tera (Universität, Vienna). J. Inorg. & Nuclear Chem. 15, 177-81(1960) Sept. (In German)

The existence of negatively charged chloride complexes of thorium was investigated. Since it is a well-known fact that in aqueous solutions containing hydrochloric acid no such complexes are formed, different alcohols of the aliphatic series were substituted for water. Through the measurements of the distribution coefficients at different acidities of hydrochloric acid and at varying concentrations of alcohols, it is concluded that the adsorption of thorium on strongly basic anion exchangers is very high if the alcohol is present in a very high percentage. At the same time the amount of hydrochloric acid present (i.e., the over-all acidity of the solution) resulted in no effect on the adsorption of thorium on these exchangers. By means of column operations, the batch experiments, which led to the determination of the distribution coefficients and an adsorption isotherm, were verified. (auth)

1470

SPECIES INVOLVED IN THE ANION-EXCHANGE ABSORPTION OF QUADRIVALENT ACTINIDE NITRATES. J. L. Ryan (General Electric Co., Richland, Wash.). J. Phys. Chem. 64, 1375-85(1960) Oct.

The anion-exchange absorption of the quadrivalent actinides is compared with spectrophotometric and solubility data. The plutonium, neptunium, and uranium species absorbing on anion exchangers from nitric acid and from calcium nitrate are $Pu(NO_3)_6^{2-}$, $Np(NO_3)_6^{2-}$, and $U(NO_3)_6^{2-}$. The data indicate that in the case of thorium, $Th(NO_3)_6^{2-}$ is absorbed. The presence of distinct maxima in the anion exchange distributions of the quadrivalent actinides in nitric acid is attributed to the formation of $HM(NO_3)_6^-$ and $H_2M(NO_3)_6$ at high acidity. The marked similarity between anion exchange of metal complexes and the solubility of quaternary amine salts of these complexes is pointed out. (auth)

1471

A METHOD FOR THE SEPARATION OF GOLD IRRADIATED MERCURY ISOTOPES. W. Parker (Univ. of Uppsala). Nuclear Instr. & Methods 8, 354(1960) Sept. (In English)

Constructional details are given for an apparatus for the separation and deposition of mercury from irradiated gold. The apparatus consists of two cups joined together to form a Dewar flask with provisions made for containing the gold sample and for evacuating the assembly, and in operation it functions as a vacuum evaporator. (D.L.C.)

1472

SOME ASPECTS OF URANIUM SOLVENT EXTRACTION WITH DODECYLPHOSPHORIC ACID. Tadeusz S. Urbański (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 341-53(1960). (In Polish)

The saturation capacity of $U^{(VI)}$ in dodecylphosphoric acid (DDPA) and the molar ratio of DDPA : $U^{(VI)}$ (1.65 : 1) were established. The data showed that the extraction mechanism is somewhat complicated. The influence of contact time, aqueous phase acidity; SO_4 concentration; and presence of $Fe^{(III)}$, $Fe^{(II)}$, and Al in various concentrations on various diluents for DDPA on $U^{(VI)}$ solvent extraction were studied. It was found that the extraction equilibrium is achieved after about 20 min. The relation between extraction coefficient E_w^0 and H_2SO_4 concentration is given by the equation $\log E_w^0 = 0.244\ C_{H_2SO_4} + K$. E_w^0 is inversely proportional to $\sqrt[3]{[H^+]}$ and $[H^+]$ for pH > 2 and pH 0.5 to 2, respectively. The presence of SO_4 to 1 M has a very small effect on the E_w^0 value; but for the molar ratio $SO_4 : U^{(VI)} < 4:1$, a rapid rise in E_w^0 occurs. The $Fe^{(III)}$ presence in concentrations to 10 g/l does not effect the $U^{(VI)}$ extraction and aluminum in the same concentration does but not markedly. The $Fe^{(III)}$ presence lowers the E_w^0 value considerably; but when the molar ratio $Fe^{(III)} : U^{(VI)} > 1$, the E_w^0 is constant. E_w^0 for $U^{(VI)}$ in concentration 10^{-3} M does not depend up on $U^{(VI)}$ concentration. $U^{(VI)}$ stripping from the organic phase of DDPA with HCl and $HClO_4$ in various concentrations was studied. The stripping ability of $HClO_4$ is much weaker than that of HCl so that the introduction of complexing anions is needed. Using 10 M HCl for the stripping, equilibrium is achieved after 2 min. The organic phase storage during 14 days has no effect on the stripping value. (auth)

1473

KINETICS OF EXCHANGE REACTIONS BETWEEN LIQUID BISMUTH–RARE EARTH ALLOYS AND FUSED SALTS. H. M. Katz, F. B. Hill, and J. L. Speirs (Brookhaven National Lab., Upton, N. Y.). Trans. Met. Soc. AIME 218, 770-5(1960) Oct.

Measurements were made of the over-all rates of the exchange reaction between a Bi-Mg-Sm alloy and the NaCl-KCl-$MgCl_2$ eutectic at 500°C, using the falling-liquid-drop technique. The data are in agreement with the theoretical predictions of a model in which it is assumed that the over-all reaction rate is controlled by mass transfer processes. Further experiments are required to confirm the validity of the model. (auth)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

1474 NAA-SR-Memo-2920

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

A STUDY OF VARIOUS TYPES OF FREEZE TYPE LIQUID METAL VALVES. E. O. Dryer. July 28, 1958. 13p. OTS.

Sketches which illustrate and describe some of the current thinking on freeze type liquid-metal valves are presented. (J.R.D.)

1475 NAA-SR-Memo-3984

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

NaK FREE CONVECTION COOLED SHAFT FREEZE SEAL FOR SRE PUMPS. F. Perez. June 18, 1959. 22p. OTS.

An investigation was conducted to determine the feasibility of using an NaK free-convection-cooled shaft freeze seal on the SRE main sodium pumps. The use of sodium in this application instead of tetralin eliminates the carburization hazard present should the seal coolant (tetralin) leak into the sodium system. Results and recommendations are included. (J.R.D.)

1476 NP-9389

Cornell Univ., Ithaca, N. Y.

ULTRA-HIGH VACUUM METAL PHYSICS MEASUREMENT OF LOW PRESSURES OF OXYGEN. Technical Report No. 3. Lee H. Rovner. Oct. 1, 1960. 38p. Contract Nonr-401(31), Nr-036-035.

The effects of oxygen reactions with the hot filaments in a cold cathode ionization gage of Redhead's design were investigated. The usefulness of this gage in measuring low oxygen pressures was evaluated in terms of a hot filament Bayard-Alpert gage. The pumping speed and other high-vacuum operating characteristics of a reduced-size cold cathode gage were compared with those of a conventional cold cathode gage. The pumping speed of both gages was high and showed considerable dependence on the pretreatment of the gages. An omegatron mass spectrometer gage was used to investigate the interactions of oxygen at low pressures with hot filaments. The dependence of the production of CO and CO_2 on filament composition and temperature was studied. Production of CO was promoted by carbon contained in the filaments, by high filament temperatures, and by the accelerating potentials used in operating hot filament gages. (auth)

1477 IG-Inf.-Ser.-61

THE DESIGN OF THRUST BEARINGS WITH HYDRODYNAMIC LUBRICATION. H. Drescher. Translated by R. G. Evan from Konstruktion 8, No. 3, 94-104(1956). 30p.

The design of continuously working journal bearings with hydrodynamic lubrication is considered. Factors which are relevant to the calculation of the minimum permissible thickness of the oil gap are discussed. Only the plain or even wedge gap is considered. (C.J.G.)

1478

HIGH-EFFICIENCY, LONG-LIVED VACUUM COLD TRAP. J. W. Butler (U. S. Naval Research Lab., Washington, D. C.). Nuclear Instr. & Methods 8, 211-16(1960) Aug. (In English)

The construction and performance of a vacuum cold trap for pump oil, "O"-ring, and other vapors are described. The trap has a capacity of 16 liters of liquid nitrogen, and lasts 5 days on one filling when clean. After a period of about 6 months to 1 year of continuous use, the lifetime has dropped to about 3 days. The trap has high pumping speed, and very high trapping efficiency, requiring a minimum of 3 successive cold-surface collisions for a molecule migrating through the trap. The principles of design include the use of very thin re-entrant tubes for mechanical support of the cold reservoir, thus minimizing conduction heat transfer; an inner tube for pumping and trapping; shields for reducing radiation heat transfer; and gold-plating for

opposing surfaces having different temperatures. Mercury and oil diffusion pump systems are compared. (auth)

1479

IMPROVEMENTS IN OR RELATING TO THE TREATMENT OF FLUIDS. Donald Arthur Oliver and Charles Alan Judson (to Birmingham Small Arms Company Ltd.). British Patent 842,314. July 27, 1960.

A method of heating a fluid for power extraction purposes comprises passing the fluid through the pores of a porous body with incorporated radioactive material, e.g., uranium, which generates heat. The porous body may be fabricated by powder metallurgical methods, and drawings of a proposed apparatus for containing the porous body and a circuit for transferring heat from the first fluid to a second fluid are given. (D.L.C.)

1480

APPARATUS FOR CONTROLLING GAS PRESSURE. Reuben Redstone and John Buckingham (to United Kingdom Atomic Energy Authority). British Patent 850,950. Oct. 12, 1960.

A hydrogen replenisher that can be used for regulating pressures at low values, e.g., 0.005 mm Hg or less, is designed, comprising a spongy support of sintered nickel powder impregnated with a fine powder of a hydride such as titanium or zirconium hydride and supported in a glass envelope together with a heater. The atomic ratio of hydrogen to titanium is preferably 0.2 to 1, so that excess titanium is present to function as a getter to prevent poisoning. Other advantages of such a replenisher are that it is rapid both in liberating and absorbing hydrogen down to the 1-μ pressure region, the hydride particles cannot be shaken out, and the pressure vs. temperature characteristics do not change. Replenisher failure occurs only in the case of severe contamination, e.g., an undetected slow leak. (D.L.C.)

Heat Transfer and Fluid Flow

1481 AD-235082

Princeton Univ., N. J.

HEAT TRANSFER FROM AN IONIZED GAS TO A GASEOUS COOLANT. First Semi-Annual Progress Report for the Period February 1 to July 31, 1959. Aeronautical Engineering Report No. 487-a. Jerry Grey. Aug. 31, 1959. 74p. Contract Nonr 1858(31).

A program was initiated to study transport properties in the mixing region between hot, partially ionized argon and helium coolant. Regimes programmed for investigation are turbulent mixing, laminar mixing, and diffusion. A principal objective is to measure the departure from prior determinations caused by extreme temperature gradients, large ionized fractions, high radiation intensities, and non-equilibrium flows. A first-order calculation of the laminar and turbulent mixing characteristics was formulated using a previously established integral method. Experimental apparatus for use in the investigations is almost complete. A preliminary literature search was conducted and a bibliography of 199 references on heat transfer from ionized gases to gaseous coolants is included. (J.R.D.)

1482 AD-236492

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

DETERMINATION OF HEAT TRANSFER COEFFICIENTS FOR CIRCULAR REACTOR FUEL ELEMENTS WITH RADIAL FLOW (thesis). Earl D. Payne and Lewis G. Kirchner. Mar. 1960. 39p.

The heat-transfer coefficient for radial air flow between the surfaces of washer-shaped heating elements stacked in cascade was investigated at Reynolds numbers of 300 to 3000. Heating-element failures limited the surface-to-air temperature difference to a maximum of 515°F. The data were extrapolated to a temperature difference of 1050°F, and a comparison was made between this geometry and an equivalent rectangular channel relative to the heat-transfer coefficient and pressure drop. (C.J.G.)

1483 AFCRC-TN-59-449

Tufts Univ., Medford, Mass.

ON SOLUTIONS OF THE HEAT EQUATION. Scientific Report No. 2. James A. Clarkson and Dawson G. Fulton. July 21, 1959. 28p. Contract AF19(604)-1578. (AD-235068).

Solutions are given to equations describing the heat flow in a semi-infinite rod, regarded as initially being at temperature zero throughout. If its free end is maintained at a temperature specified by a drive function f(t) for all $t > 0$, then its temperature for all positive x and t is denoted by H(f; x,t). Previously published laboratory results suggested that the function of H given by the expression $I(f; x,T) = \int_0^T (H_x^2 - HH_{xx})dt$ could never be negative. It is shown that I(f; x,T) can be negative for certain values of x and T, even for comparatively uncomplicated drive functions f(t). (C.J.G.)

1484 CF-60-10-40

Oak Ridge National Lab., Tenn.

THE EFFECT OF GAS FILM RESISTANCE IN DIFFUSION FROM A POROUS SEPTUM INTO A FLUID STREAM. A. R. Saunders. Oct. 10, 1960. 10p. OTS.

The theory of mass transfer into a flowing fluid is utilized to estimate the effect of gas film resistance on over-all rates of transfer through a porous septum. The expressions developed for the mass transfer ratio, Nu_f/Nu_M, are given. In laminar rodlike flow at $Gz > 50$

$$Nu_f/Nu_M = 1.27 \frac{D_G}{D_{EM}} Gz^{0.5}$$

and for turbulent flow at $Re > 2100$

$$Nu_f/Nu_M = 0.023 \frac{D_G}{D_{EM}} Re^{0.86} Sc^{0.44}.$$

For the system under consideration the mass transfer ratio is 100 to 1000, indicating that transfer through a gas film is ordinarily a fast process compared to diffusion across a porous membrane. (auth)

1485 TID-6568

Minnesota. Univ., Minneapolis. Heat Transfer Lab.

PROGRESS REPORT FOR RESEARCH ON HEAT TRANSFER TO FLUIDS FLOWING THROUGH NON-CIRCULAR CHANNELS. [Period Covered] March to September 1960. E. R. G. Eckert and J. L. Novotny. Sept. 1960. 55p. Contract AT(11-1)-659. OTS.

Investigations were made in the following areas: theoretical and experimental laminar and turbulent pressure-drop studies; experimental turbulent heat-transfer studies; and theoretical turbulent heat-transfer studies. The analytical and experimental program to determine the pressure drop for turbulent flow in rectangular ducts was completed. These results are presented and explained in detail. It is planned to measure the heat transfer for rectangular ducts with aspect ratios of 1:1, 5:1, and 10:1, thereby determining the effect of aspect ratio on the Nusselt number for fully developed flow. The calculations concerning the turbulent heat transfer for flow through rectangular ducts was completed for the following case: constant wall temperature around the circumference with constant heat input per unit length. (W.L.H.)

1486 TID-6648

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

GREEN'S FUNCTION FOR A CIRCULAR RING WITH RADIATION TYPE BOUNDARY CONDITIONS. James F. Heyda. Aug. 1960. 11p. Contracts AF33(600)-38062 and AT(11-1)-171. (XDC-60-8-120). OTS.

Green's function for the potential equation for a circular ring under radiation type boundary conditions is derived. Analytical solutions for many problems in fluid flow and steady-state heat conduction in hollow cylinders may be obtained with its aid. (W.D.M.)

1487 AEC-tr-4278

HEAT TRANSFER OF SOLIDS HEATED IN LIQUIDS BY VAPOR FORMATION WITH CONSIDERATION OF FLOW CONDITIONS. H. Bühler and F. J. Schmidt. Translated by L. L. Smith from Atomkernenergie 5, 18-22(1960). 10p. JCL.

A review of technology related to the heat transfer of solids in liquids by vaporization is presented. Heat-transfer measuring methods are discussed, and the thermodynamics of the cooling process as a function of the temperature of solids is examined. (J.R.D.)

1488

SPINED TUBES IN CROSS-FLOW EXCHANGERS. John L. Lockard and James H. Weber (Univ. of Nebraska, Lincoln). Ind. Eng. Chem. 52, 925-8(1960) Nov.

To obtain a better understanding of the performance of extended surfaces in cross-flow exchangers, a series of experiments were carried out in which momentum and heat transfer data were obtained on this type of exchanger by utilizing spined tubes. Friction factors and heat transfer coefficients were calculated from the experimental results and correlated with a modified Reynolds number. The correlations were qualitatively similar to those obtained for cross flow exchangers using smooth tubes. The performances of spined tube and smooth tube exchangers were compared. If the momentum and heat transfer characteristics of these exchangers are combined in a power performance factor alone, the advantage of the smooth tube cross-flow exchanger is evident. (auth)

1489

EXPERIMENTAL METHODS APPLIED TO THE DETERMINATION OF SOME TEMPERATURE RADIATION PARAMETERS. D. T. Kokorev (Inst. of Chemical Engineering, Moscow). Intern. J. Heat and Mass Transfer 1, 23-7(1960) June. (In English)

The analytical determination of integral angular radiation factors is very complicated for most practical cases. Known methods do not present a satisfactory solution of the problem as a whole. In this work the problem is solved experimentally. Analytical relations were obtained, which make it possible to establish simple experimental methods of determining angular radiation factors for a general case of a spatial problem, which plays an important role in the solution of heat-transfer problems by radiation. It was possible to find the optical characteristics of gray surfaces: the average factors of absorption, reflection, and radiation. (auth)

1490

A MECHANISM OF TURBULENT HEAT TRANSFER IN LIQUID METALS. N. Z. Azer (Univ. of Alexandria, UAR (Egypt)) and B. T. Chao. Intern. J. Heat and Mass Transfer 1, 121-38(1960) Aug. (In English)

A mechanism of turbulent heat transfer is proposed based on a modification of Prandtl's mixing-length hypothesis. It is assumed that there is a continuous change of momentum and energy during the flight of the eddy. Two expressions are obtained for the eddy diffusivity ratios for heat and momenta for fully developed pipe flow. One is for fluids of Prandtl number 0.6 to 15 and the other is for liquid metals. Both correctly predict the influence of Reynolds number, Prandtl number, and radial location across the pipe on the diffusivity ratio when compared to trends revealed by limited published data. Computations of Nusselt number and temperature profile in liquid metals were carried out under conditions of constant wall flux using the deduced expression for the diffusivity ratio. The computed values agree well with experimental results. For practical calculations of film coefficients of heat transfer, the following interpolation formula may be used: $N_{Nu} = 7 + 0.05\, N_{Pr}^{0.25}\, N_{Pe}^{0.77}$, which fits the calculated data with a maximum deviation of <12% for N_{Pr} <0.1 and N_{Pe} <15,000. Limiting values of Nusselt number as $N_{Pr} \to 0$ and $N_{Re} \to \infty$ are discussed. (auth)

1491

ON THE CORRELATION OF NUCLEATE BOILING HEAT TRANSFER. K. Nishikawa and K. Yamagata (Kyushu Univ., Fukuoka). Intern. J. Heat and Mass Transfer 1, 219-35 (1960) Aug. (In English)

A generalized equation to describe nucleate boiling is derived. The expression which correlates all fluid independently of pressure and heating surface-fluid combination is as follows: $Y = 8.0(f_c^{1/4}\, f_p X)^{3/4}$. It is indicated that this correlating equation is applicable to forced-convection saturated or surface boiling. The proposed correlating equation was theoretically sought by analyzing the elementary processes of the phenomena, but it is not based on dimensional analysis. In order to reach the final solution of the problem, it is necessary to analyze the elementary processes of boiling phenomena and elucidate the relations underlying the problem. (auth)

1492

A COOLING PROBLEM OF PEBBLE-BED NUCLEAR REACTORS. L. S. Dzung (Brown, Boveri & Co., Baden, Switzerland). Intern. J. Heat and Mass Transfer 1, 236-41(1960) Aug. (In English)

The fundamental equations for the steady-state flow of a gas through a porous medium with prescribed heat source are derived. Applications of the equations allow the calculation of pressure drop and flow distribution of a gaseous coolant in a pebble-bed reactor. One exact solution is given. The maximum gas temperature is found to be very much higher than the mixed mean value. (auth)

1493

DEVELOPMENT OF FLOW IN A LOOP AFTER PUMPING STARTUP. David Burgreen (Nuclear Development Corp. of America, White Plains, N. Y.). Nuclear Sci. and Eng. 8, 277-8(1960) Sept.

An analytical method used to approximate flow coastdown in a loop without knowledge of pump characteristics is extended to the problem of pump startup at constant applied torque. Differential equations are derived expressing the ratio of the transient flow to steady-state flow Q in terms of the ratio of the fluid energy to the energy stored in the pump α and of the loop half time $t_{\frac{1}{2}}$ (time required for the loop flow to drop to half its initial flow when the pump is cut off from the loop); the equations are solved and the solutions plotted on a Q vs. T (ratio of elapsed time to $t_{\frac{1}{2}}$) graph at various α values. The results, compared with those obtained from pump characteristic curves, give close agreement for small α values (high-inertia impellers) and small discrepancies for large α values (low-inertia impellers). (D.L.C.)

1494

WALL TEMPERATURE AND HEAT FLUX MEASUREMENT IN A ROUND TUBE. A. I. Morgan, Jr. and Robert A. Carlson (Western Regional Research Lab., Albany, Calif.). Paper No. 60-HT-1. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 5p.

A method of measuring the mean temperature and heat flux into or out of any region along a metal tube was devised by converting the tube into a series of resistance thermometers and using both d-c and a-c. The d-c resistance measures the mean tube temperature; while, because of the skin effect, the a-c impedance favors the temperature of the outer surface of the tube. A comparison of the two measurements gives the heat flux through the metal as well as the outer and inner surface temperatures. The design of the tube and associated circuitry is shown adapted as an evaporator for fouling studies, and equations for the behavior of the tube are given. Variance analysis showed that the uncertainty in heat flux estimation is proportional to the cube root of the heat flux but not to the tube temperature. Single heat-flux determinations are accurate to about $\pm 2 \times 10^4$ Btu/hr-ft^2. (D.L.C.)

1495

EFFICIENCY OF FINNED ANNULAR PASSAGES. Allan D. Kraus (Sperry Gyroscope Co., Great Neck, New York). Paper No. 60-HT-3. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, American Society of Mechanical Engineers, 1960. 4p. $1.00.

A derivation is presented for the efficiency of a finned annular passage with fins attached to both inner and outer pipe wall. For an assumed set of conditions, this configuration is then compared to a finned annulus with fins attached to inner pipe only and then to a simple double-pipe annulus with no fins. The comparisons indicate a significant improvement over the bare and finned inner-tube arrangements. (auth)

1496

FORCED CONVECTION HEAT TRANSFER FROM AN ISOTHERMAL SPHERE TO WATER. G. C. Vliet and G. Leppert (Stanford Univ., Calif.). Paper 60-HT-5. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 8p.

Heat transfer from a spherical heating element by forced convection occurs in many situations of practical importance. Previously reported measurements of convective heat-transfer coefficients from spheres to liquids are correlated with new measurements taken at much higher Reynolds numbers and with substantial temperature difference between the heating surface and the liquid. The significance of the larger temperature difference is twofold: Since the viscosity variation of liquids with temperature is usually strong, there may be an important viscosity change across the boundary layer. Furthermore, natural convection effects may not be ignored in regions of large temperature difference and low or moderate Reynolds number. Both of these effects are discussed. (auth)

1497

HEAT TRANSFER TO LAMINAR FLOW ACROSS A FLAT PLATE WITH A NONSTEADY SURFACE TEMPERATURE. R. D. Cess (Westinghouse Research Labs., Pittsburgh). Paper No. 60-HT-7. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 6p.

Forced convection heat transfer is considered for laminar flow across a flat plate whose surface temperature varies with time. The case analyzed first is that of a step change in surface temperature, and series solutions are obtained which apply for both small and large times. These series results are used to construct an approximate solution that describes the entire time-history of the nonsteady heat-transfer process, and it is found that the results agree closely with an envelope composed of pure transient conduction and steady-state convection solutions. The analysis is then generalized to include any prescribed variation of surface temperature with time. (auth)

1498

RADIATION HEAT TRANSFER IN A SPHERICAL ENCLOSURE CONTAINING A PARTICIPATING, HEAT-GENERATING GAS. E. M. Sparrow (Univ. of Minnesota, Minneapolis), C. M. Usiskin, and H. A. Hubbard. Paper No. 60-HT-9. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 8p.

An analysis is made of the thermal radiation in an absorbing-emitting nonisothermal gas confined in a hollow spherical enclosure or in the space between two concentric spheres. The gas is gray and contains a volume heat source, whereas the bounding walls are black and isothermal. The conservation of energy principle yields an integral equation that is solved for a wide range of geometric and radiative conditions. It is found that as the absorption coefficient increases in a fixed geometry, the gas temperature decreases and becomes more nonuniform. On the other hand, as the enclosure size increases, the gas temperature increases and becomes more nonuniform. An approximate analysis using a conduction-type transfer law is carried out, and the results are compared with the integral equation solutions. (auth)

1499

AN EXPERIMENTAL STUDY OF BOILING IN REDUCED AND ZERO GRAVITY FIELDS. C. M. Usiskin and R. Siegel (Lewis Research Center, Cleveland). Paper No. 60-HT-10. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 9p.

A pool boiling apparatus was mounted on a counterweighted platform that could be dropped a distance of nine feet. By varying the size of the counterweight, the effective gravity field on the equipment was adjusted between zero and unity. A study of boiling burnout in water indicated that a variation in the critical heat flux according to the one quarter power of gravity was reasonable. A consideration of the transient burnout process was necessary in order to properly interpret the data. A photographic study of nucleate boiling showed how the velocity of freely rising vapor bubbles decreased as gravity was reduced. The bubble diameters at the time of breakoff from the heated surface were found to vary inversely as gravity to the 1/3.5 power. Motion pictures were taken to illustrate both nucleate and film boiling in the low gravity range. (auth)

1500

HEAT TRANSFER AND PRESSURE DROP IN AN ANNULAR GAP WITH SURFACE SPOILERS. G. A. Kemeny and J. A. Cyphers. Paper No. 60-HT-15. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17,

1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 9p.

Heat-transfer and pressure drop data are presented for turbulent water flow in the annular space between concentric tubes. Heat was transferred to the liquid from the inner surface, which was equipped with various surface spoiler configurations. A common outer tube was used, which was maintained smooth and adiabatic for all tests. An empirical formula is given which correlates friction factors for circular tubes and annular gaps or narrow flat passages with semicircular spoilers on either one or both sides. The use of such friction factors in the Martinelli equation for turbulent heat transfer gives satisfactory estimates of the heat transfer for spoiler configurations. (auth)

1501

SHELL-AND-TUBE HEAT EXCHANGERS: EFFECT OF BY-PASS AND CLEARANCE STREAMS ON THE MAIN STREAM TEMPERATURE. Byron E. Short (Univ. of Texas, Austin). Paper No. 60-HT-16. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 8p. $1.00.

Ideally the clearance and by-pass streams in a shell-and-tube heat exchanger are not in contact with heat-transfer surface as is the main stream which flows over and around the tubes. Consequently, the temperature of these two streams decreases or increases only as a result of the fluid which flows from the main stream because of viscosity changes and mixes with each of the other two streams. The temperature of the main stream at the exit of the exchanger is quite different from the mixed mean temperature of the fluid leaving the exchanger. As a result the heat-transfer coefficient and the pressure drop computed for the exchanger on the basis of the mixed mean-temperature condition are quite different from the true values, especially in the laminar-flow region. (auth)

1502

HEAT TRANSFER TO WATER IN TURBULENT FLOW IN INTERNALLY HEATED ANNULI. PART 1. STATIONARY FLOW. Z. Rotem and I. Shai (Israel Inst. of Tech., Haifa). Paper No. 60-HT-20. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 4p. $1.00.

Values of local heat transfer coefficients in turbulent flow of water through a circular concentric annular duct were obtained. The outside-to-inside diameter ratio used was 1.593. Uniform core-wall heat flux was used with very low fluid temperature rise to reduce longitudinal conduction and to approximate the constant wall-temperature case. A total of 450 points was taken. A Colburn type of correlation was obtained and compared with other correlations previously published. (auth)

1503

HEAT TRANSFER TO WATER IN TURBULENT FLOW IN INTERNALLY HEATED ANNULI. PART 2. PULSATING FLOW. I. Shai and Z. Rotem (Israel Inst. of Tech., Haifa). Paper No. 60-HT-21. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 5p. $1.00.

Measurements of pulsating flow heat transfer were undertaken on an annular duct with a heated core tube. The test installation was first checked carefully to give reasonable correlation with published data on stationary flow heat transfer in circular, concentric annuli. A total of 33 series of test runs (165 points) was then taken with pulsating flow. Within the range of frequencies and pulsation ratios tested, no significant change in heat-transfer coefficients was obtained. (auth)

1504

POOL BOILING IN AN ACCELERATING SYSTEM. Herman Merte, Jr. and J. A. Clark (Univ. of Michigan, Ann Arbor). Paper No. 60-HT-22. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineering, 1960. 10p.

A study is reported of the influence of system acceleration (1 to 21 g) on pool boiling heat transfer using distilled water at approximately atmospheric pressure. The acceleration of the system is such that the resulting force field is normal to the heating surface, thereby increasing the buoyant forces acting on the vapor bubbles. Heat-flux rate is varied from approximately 5000 Btu/hr-ft^2 (nonboiling) to 100,000 Btu/hr-ft^2. Data are presented for the influence of subcooling with the boiling system under acceleration at the lower values of heat flux. A preliminary analysis is presented for a theoretical description of the process of boiling under the influence of high acceleration, including the simultaneous effect of natural convection. (auth)

1505

HEAT TRANSFER BY A TURBULENTLY FLOWING FLUID-SOLIDS MIXTURE IN A PIPE. C. L. Tien (Univ. of California, Berkeley). Paper No. 60-HT-23. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 6p.

Analysis is made on the heat transfer by a turbulently flowing fluid with suspended small solid particles in a circular pipe. Temperatures in the system are assumed to be less than about 1000°F, so that radiation effects are negligible. The loading ratio of solids to gas based on mass is less than or equal to one in the present investigation. The governing equations for the system are derived as two coupled linear equations. With approximations, the governing equations with their boundary conditions reduce to a form of the corresponding governing equation for the one-phase heat-transfer system. Computations of the solution are accomplished by use of the solutions in the one-phase case. The final results are compared with existing experimental data and are discussed. (auth)

1506

TRANSIENT NATURAL CONVECTION FROM VERTICAL ELEMENTS. B. Gebhart (Cornell Univ., Ithaca, N. Y.). Paper No. 60-HT-33. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 13p. $1.00.

The transient natural-convection process is analyzed using an integral method of analysis. Differential equations are derived which relate average surface temperature and time for either heating or cooling for vertical elements having arbitrary thermal capacity. The equations are applicable to laminar flow for all fluids. The coefficients are Prandtl-number dependent and are estimated for Prandtl numbers in the range of 0.01 to 1000. A solution of the equations is presented for the extreme case of a vertical plate of negligible thermal capacity subjected to a step in flux at its surface. Fluids having Prandtl numbers of 0.01, 0.1, 0.72, 1.0, 5, 10, 100, and 1000 are considered. The results, in terms of generalized variables, are practically independent of Prandtl number. Simple one-dimensional transient behavior is followed for approximately 20% of the transient with a subsequent quick approach to the asymp-

totic value. The results show no substantial overshoot of the average surface temperature. It is doubted that significant temperature overshoot actually occurs for vertical surfaces even for a step in flux. (auth)

1507

BURNOUT IN TURBULENT FLOW—A DROPLET DIFFUSION MODEL. K. Goldmann (Nuclear Development Corp. of America, White Plains, N. Y.), H. Firstenberg, and C. Lombardi. Paper No. 60-HT-34. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 8p. $1.00.

Two-phase flow regimes are reviewed briefly. A physical model, based on the concept that droplet diffusion through a steam boundary layer is the limiting mechanism for burnout in turbulent flow, is described. An equation is derived relating burnout to other parameters in fog flow. With simplifying assumptions, an order-of-magnitude agreement between analysis and experimental burnout data in fog flow is demonstrated. (auth)

1508

FILM COOLING WITH MULTIPLE SLOTS AND LOUVERS. J. H. Chin, L. E. Hayes, S. C. Skirvin, and F. Burggraf (General Electric Co., Cincinnati). Paper No. 60-HT-35. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 12p. $1.00.

Experimental results are presented for film cooling of an adiabatic plate downstream of one to ten slots and two to twenty rows of discrete punched louvers in a subsonic turbulent flow under zero pressure gradient. The adiabatic wall temperatures downstream of the last equivalent slot were measured and correlated in terms of the flow parameters, equivalent slot number and slot spacing, and distances downstream of the last equivalent slot. (auth)

1509

NATURAL-CIRCULATION TESTS WITH WATER AT 800 TO 2000 PSIA UNDER NONBOILING, LOCAL BOILING AND BULK BOILING CONDITIONS. O. J. Mendler, A. S. Rathbun, N. E. Van Huff, and A. Weiss (Westinghouse Electric Corp., Pittsburgh). Paper No. 60-HT-36. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 17p. $1.00.

Natural- and forced-circulation test data for a closed-loop system are presented and analyzed. The data were obtained at pressures of 800, 1200, 1600, and 2000 psia from a natural-circulation loop by using single rectangular channel test sections (0.100 in. × 1.0 in. × 27.0 in. long; 0.200 in. × 1.0 in. × 27.0 in. long; and 0.250 in. × 1.0 in. × 27.0 in. long). Heat fluxes ranged from 50,000 Btu/hr-ft^2 to burnout with inlet subcoolings of 20, 70, and 100°F. The results showed that single- and two-phase pressure drop; burnout heat flux; and riser density, measured under natural-circulation operation, are no different from those measured with forced circulation at the same thermal and fluid flow conditions. For the loop studied, it was shown that natural-circulation-loop flow rates can be predicted to within 10% for both single- and two-phase flow. Some data for slip ratios at liquid velocities less than ½ fps and for two-phase exit losses were obtained. Flow fluctations were noted during some of the natural-circulation runs; these occurred before burnout heat flux was reached. In some instances these fluctations were severe enough to cause a premature burnout. (auth)

Instrumentation

1510 AERE-M-566

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE SATURATION CHARACTERISTICS OF MEAN-CURRENT FISSION IONISATION CHAMBERS. J. A. Dennis and W. R. Loosemore. Aug. 1960. 25p. BIS.

A study was made of the saturation characteristics of mean current ionization chambers with gas fillings of neon, xenon, and nitrogen in which the ionization is due to fission fragments from U^{235}. Electrode spacings of 0.5 to 2.0 mm and gas pressures of 360 to 3600/mm Hg were employed; it is shown that the best characteristics are obtained at the smaller electrode spacings and lower gas pressures. (auth)

1511 AERE-N/M-53

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

A COINCIDENCE COUNTER FOR SLOW α COUNTING. H. S. Cockroft. June 6, 1951. 5p.

The design of a $4\pi/60$ solid angle coincidence counter for slow α counting is presented. The counter has a resolution of 6% and uses coincidence counting to reduce background. (C.J.G.)

1512 AERE-R-3281

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

RESOLUTION MEASUREMENTS ON THE NEUTRON BOOSTER TIME OF FLIGHT SPECTROMETER. C. A. Uttley and R. H. Jones. July 1960. 32p. BIS.

An experimental investigation of the resolution of the neutron-booster time-of-flight spectrometer is described, and the results are compared with a theoretical estimate. Reasonable agreement is obtained for both the width and shape of the resolution function indicating a resolution of about 1 mμsec per meter on the 300-m flight path. (auth)

1513 CF-60-9-67

Oak Ridge National Lab., Tenn.

INSTRUCTION MANUAL, MERCURY RELAY PULSE GENERATOR MODEL Q-1212C. E. Fairstein. Sept. 20, 1960. 10p. OTS.

The electrical characteristics and control features of a mercury-relay pulse generator are described. Operating characteristics are discussed relative to stability, output connections, signal shaping, application, and calibration. (C.J.G.)

1514 DP-498

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

AN ELECTRON MULTIPLIER AS A DETECTOR FOR A SURFACE IONIZATION MASS SPECTROMETER—DESIGN. LeConte Cathey. Aug. 1960. 18p. Contract AT(07-2)-1. OTS.

A description of a 14-stage electron multiplier for use in amplifying the detector signals in a surface ionization mass spectrometer is given. The system can either measure the multiplier anode current or count the anode pulses. Pulse counting may be used for signal currents in the range from 10^{-13} to 10^{-18} amp. The range of the normal electrometer circuit is extended by the electron multiplier so that it measures currents from 10^{-10} to 10^{-15} amp with a fast response. (auth)

1515 MRL-71

Watertown Arsenal. Materials Research Lab., Mass. and Watertown Arsenal. Ordnance Materials Research Office, Mass.

A STEP SCANNER FOR EXPERIMENTS ASSOCIATED WITH A NUCLEAR REACTOR. J. J. Antal and T. F. Zagaeski. Feb. 1960. 25p. DA Project 5-93-32-001. (AD-235654).

The design and operation of a unit employing a step motor to advance a small mechanical or electromechanical device in precise increments over a large angular range with automatic programming of this operation with a counting cycle and paper tape read-out of all pertinent information are described. The circuitry is described in detail to facilitate operation and maintenance of the unit. The unit is useful in facilitating procedures such as single-channel analysis, slit scanning during neutron beam alignment, and angular rotation of a crystal spectrometer. (auth)

1516 NP-9153
Joint Inst. for Nuclear Research, Dubna, U.S.S.R.
MAGNITOSTRIKTSIONNYE LINII ZADERZHKI. (Magnetostriction Delay Lines). I. M. Beskrovnyĭ. 1960. 38p. (JINR-P-496).

The theory of magnetostriction lines is discussed, and a calculation method is suggested for estimating transition line characteristics for optimum and practical cases. The factors affecting the signal amplitude and temperature stability and methods for damping reflected signals are analyzed. Theoretical and experimental data are correlated and descriptions are given of a four-channel memory block. Possible applications of magnetostriction delay lines are suggested. (R.V.J.)

1517 NP-9166(p.229-34)
Banaras Hindu Univ., Banaras, India.
ADAPTATION OF CHEMLA TYPE OF SOLID-ION SOURCE TO MASS SPECTROMETERS. H. J. Arnikar.

A thermal solid-ion source designed by Chemla is designed so that it is readily adaptable to mass spectrometers of the gas-ion source type. The source comprises a 2-cm length of tungsten spiral stretched across two vertical pins and mounted on a reflecting electrode inside a large accelerating electrode structure with an aperture. The tungsten spiral is momentarily heated red-hot to oxidize the surface, and a drop of the solution of the element to be analyzed is placed over the center of the spiral which is then dried. The assembly is evacuated and the ions are generated by heating the spiral with a 2-volt battery. (D.L.C.)

1518 NP-9166(p.264-71)
Delhi. Univ.
A SIMPLE TYPE OF FAST COINCIDENCE CIRCUIT OF MILLIMICROSECOND RESOLUTION. N. K. Saha and S. C. Pancholi.

A germanium diode fast coincidence circuit of nanosecond resolution is described which uses only two fast channels. The circuit, a modification of Bay's circuit, is in the form of a bridge arrangement containing two nonlinear diode elements. A single photomultiplier pulse in one channel cancels itself when the bridge is balanced; but if another pulse is present simultaneously in the other channel, a finite output signal is obtained for the coincidence. The circuit was studied with a RCA-5819 photomultiplier; in this case the possibility of the bridge balance being difficult to maintain over a large range of input pulse amplitudes was found to be nonexistent. Prompt resolution coincidence curves are presented for trans-stilbene crystals with β and γ sources. The resolution time is 1.0 to 1.5 and ~2.3 nanoseconds for trans-stilbene and anthracene, respectively, whereas the resolution curves for NaI(Tl) crystals show irregularity and asymmetrical coincidence rates. (D.L.C.)

1519 NP-9166(p.272-99)
Saha Inst. of Nuclear Physics, Calcutta.
DESIGN OF FAST OSCILLOSCOPES. B. M. Banerjee and S. C. Nath.

The design of modern fast oscilloscopes that make possible the recording of waveforms and single transients of duration as small as a few nanoseconds are discussed. Among the topics covered are the cathode ray tube, vertical and horizontal amplifiers, sweep generator, gate generator, trigger amplifier, trigger delay, recurrent sweeps, and triggered sweeps. Six oscilloscope circuits are presented. (D.L.C.)

1520 NP-9166(p.300-11)
Saha Inst. of Nuclear Physics, Calcutta.
RESOLUTION IN BINARY SCALERS. B. M. Banerjee and Sneha Choudhury.

The resolution performance of ordinary binary scalers was studied with pulse pairs or triples of known separation and binary units using tube types E90CC, 12AT7, and 12AU7. The results indicate that: (1) at the critical separation, i.e., when the pulses are so close together that the circuit fails to resolve, increased pulse amplitude, especially of the second pulse, often brings about resolution; (2) resolving time depends on anode-grid feedback, grid-ground resistance pairs, coupling capacity, shunting capacity of anode, and anode resistances; (3) the 12AT7 tube provides the shortest resolving time, although 12AU7 is not much inferior; (4) for a double pulse of critical separation and a cathod voltage just sufficient to stop cathode multivibration, the system is prone to give a delayed response to the second pulse; (5) for a triple pulse, the circuit resolves but is affected by multivibration as if it had received a fourth pulse; and (6) the resolving time cannot be related to the circuit constants by a simple function and depends to a large extent on small asymmetries. The data are tabulated, and circuits for the scaler and double and triple pulse generators are given. (D.L.C.)

1521 NP-9166(p.312-20)
Saha Inst. of Nuclear Physics, Calcutta.
THE OPERATION OF A TRANSISTOR DRIVEN SCALER. R. Roy.

A transistorized decade counting system was designed following Kandiah's suggestion that transistorized driver stages be used to operate dekatron tubes. In this way only three transistors are used in the scaler, and power consumption is 0.25 watt as compared with a consumption of 50 watts for a similar electronic-tube circuit. However, the circuit using GC10B tubes has a very poor resolving time; but it is anticipated that the GC10D tubes will give better performance. Complete details of the circuits are given. (D.L.C.)

1522 NP-9166(p.332-5)
Saha Inst. of Nuclear Physics, Calcutta.
CONSTRUCTION OF AN ELECTRON PARAMAGNETIC RESONANCE SPECTROMETER. A. Mukherji, R. Chatterji, and G. N. Sarkar.

An electron paramagnetic resonance spectrometer capable of measuring magnetic fields with an accuracy of more than 1 part in 10^4 was constructed with a 723 A/B klystron as the microwave power source and a resonant cylindrical cavity in the TE_{11} mode. Its sensitivity is about 10 μg diphenylpicrylhydrazyl, and signals having line widths up to 15 gauss can be observed with an oscilloscope. The theory of the determination of the spin and magnetic moment is briefly described and illustrated with the case of Mn^{55} ($I = 5/2$); in this way, the magnetic moment of one isotope can be determined from that of another isotope. (D.L.C.)

1523 NP-9259

Princeton Univ., N. J. Palmer Physical Lab. and Princeton Univ., N. J. Naval Ordnance Lab.

STUDIES OF A NEON FILLED SPARK CHAMBER. Technical Report No. 25. James W. Cronin and George Renninger. Sept. 15, 1960. 22p. Contract Nonr-1858(06).

A parallel plate spark chamber consisting of 19.25-in.-thick plates spaced 0.37 in. apart is described. The plates are aluminum that were copper plated and polished. The size of each plate is 7 × 9 in.; the edges are rounded to a $\frac{1}{8}$-in. radius. The performance of the apparatus is discussed and schematic drawings are included. The short sensitive time allows the chamber to operate in regions where the instantaneous flux is as high as 10^6/sec. (W.D.M.)

1524 NP-9287

Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs.

DEVELOPMENT AND FABRICATION OF NON-DESTRUCTIVE SPECIFIC GRAVITY MEASURING EQUIPMENT EMPLOYING RADIATION TECHNIQUE. Monthly Progress Report for September 1960. Report No. 58-92-PR-25. 6p. Contract DA-19-059-501-ORD-2631.

Efforts during the report period was devoted to checking the clearance for the length measuring system and initiation of measurement probe carriage assembly design. Bids on the beam attenuator assembly and test bed were reviewed and purchase orders were issued. (J.R.D.)

1525 ORNL-2730

Oak Ridge National Lab., Tenn.

A SMALL WRIST DOSIMETER FOR BETA AND GAMMA RADIATION (thesis). H. H. Hubbell, Jr., A. P. Hull, and R. D. Birkhoff. Oct. 18, 1960. 123p. Contract W-7405-eng-26. OTS.

Submitted to Vanderbilt Univ.

The principles of ion chamber design are discussed, and a personnel dosimeter embodying them is described. The device is basically a parallel-plate ionization chamber with closely spaced circular electrodes and may be worn conveniently anywhere on the body. The sensitive volume and capacitance of the chamber are chosen to permit charging and reading with Victoreen Minometers. The chamber has x and gamma radiation responses which are independent of energy above 100 kev. The maximum departure from energy independence is about 30 per cent and occurs at 50 kev. The outer, ribbed structure is made of nylon and forms a short cylinder about $1\frac{1}{2}$ in. in diameter and about $\frac{3}{4}$ in. high. Filling the space between the ribs is a conducting plastic film approximating the human epidermis in thickness and forming one plate of the chamber. The electrical capacitance is in the air gap between the plates, and in the insulating plastic base between the lower plate and the metal cap which holds the dosimeter to the wearer. Calibrations for beta particles were made with 2π geometry obtained by inserting the dosimeter in a paraboloidal cavity formed in a rotating solution of a beta-emitting isotope. The response varies from 38 to 63 per cent of the dose to the basal layer of the epidermis for isotopes emitting beta particles with average energies in water from 52 kev for S^{35} to 694 kev for Y^{90}, respectively. (auth)

1526 SCTM-239-60(14)

Sandia Corp., Albuquerque, N. Mex.

HIGH-SPEED SEQUENTIAL GATE CONTROL CIRCUITRY. Leonard Ehrman. July 29, 1960. 11p. OTS.

General design criteria for high-speed sequential gate control circuitry are discussed. Two shift registers, working at 4 and 10 Mc, are described. (C.J.G.)

1527 TID-6644

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

TRANSMISSION OF FISSION CHAMBER PULSES THROUGH LONG CABLES. J. J. Baum. Mar. 21, 1960. 15p. Contracts AF33(600)-38062 and AT(11-1)-171. (XDC-60-8-70). OTS.

The characteristics of fission chamber pulses are examined and two methods of reducing the loading effect of long cables are discussed. The first of these involves a feedback system to drive the coaxial shield and effectively reduce lead capacity, whereas the second demonstrates the beneficial effects of using a higher impedance load such as RG65/U or specially built cables. Experimental results with both systems are reported. (auth)

1528 TID-6670

Los Alamos Scientific Lab., N. Mex.

HIGH POWERED SPARK GAP SWITCHES. E. L. Kemp. [1960]. 10p. OTS.

A low-inductance vacuum gap with a large dynamic range is described. A four-electrode spark gap is shown which was designed to physically fit a 100-kv 0.8-mf capacitor and operate in parallel with several others feeding a low-inductance load. (W.D.M.)

1529 USNRDL-TR-459

Naval Radiological Defense Lab., San Francisco.

A SERVO-TYPE INTERMITTENT DIGITAL READOUT FOR PORTABLE INSTRUMENTS. D. Y. Lee. Aug. 30, 1960. 21p.

Recent studies showed that the effectiveness of the meter type readout used in most portable instruments is limited by human error. The intermittent digital readout offers a significant improvement over the scale changing meter. Interpolation and "averaging" are eliminated by static digital display, and scale factors are eliminated by a three decade linear scale. A developmental model of the intermittent digital readout was constructed and tested. Deadband is 1.05% of full scale and accuracy is +9 to −10% at any point from essentially zero to full scale. Input for full scale is +0.7 volt d-c. Although performance of the model is satisfactory, circuit refinement and improved motor design are desirable. This work has demonstrated the feasibility of the servo digital readout approach as an improvement over the meter display presently employed in portable instrument designs. (auth)

1530 CEA-tr-R-870

METHODES DE MESURE DE FAIBLES RADIOACTIVITÉS À L'AIDE DE COMPTEURS À SCINTILLATIONS. (Method of Measurement of Weak Radioactivities using Scintillation Counters). V. F. Smirnov. Translated into French from Zavodskaya Lab. 24, 989-95(1958). 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 11155.

1531 CEA-tr-R-926

ETUDE DES PROPRIETFS ET DE LA STRUCTURE DES ALLIAGES INVAR ALLIES AU MOLYBDÈNE, CHROME ET NIOBIUM. (Study of the Properties and Structure of Invar Alloyed with Molybdenum, Chromium, and Niobium). A. Z. Ivanushkina and B. G. Livshitz. Translated into French from Fiz. Metal. i Metalloved. 5, 527-35(1958). 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 13958.

1532 CEA-tr-R-936

BI-SPECTROMÈTRE–GAMMA À CANAUX MULTIPLES.

(Multiple Channel Gamma Bi-spectrometer). Yu. D. Bayukov (Iu. O. Baioukov), M. S. Kozodaev, A. A. Markov, A. N. Sinaev, and A. A. Tyapkin (Tiapkine). Translated into French by S. Tarassenko from Pribory i Tekh. Ekspt. No. 6, 30-40(1958). 29p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 5531.

1533 CEA-tr-R-953

MANOMÈTRE D'IONISATION RADIOACTIF POUR LE VIDE POUSSÉ. (Radioactive Ionization Manometer for Vacuums). A. I. Akishin. Translated into French by B. de Trezvinsky from Pribory i Tekh. Ekspt. No. 2, 78-80(1959). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 15310.

1534 JPRS-5649(p.147-54)

INSTRUMENT FOR AUTOMATIC SCANNING IN CLINICAL ISOTOPIC INVESTIGATIONS. N. A. Gabelova, O. G. Arakelov, E. (Ye.) T. Martusov, and F. M. Lyass. Translated from Med. Radiol. 6, No. 6, 61-4(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 23047.

1535 JPRS-5649(p.155-7)

SUPPLY-LINE CHARGING DEVICE FOR A DK-0.2 DOSIMETER. I. T. Tsilyuryk. Translated from Med. Radiol. 6, No. 6, 64-5(1960).

Short battery-life and small battery capacity of the DK-0.2 dosimeter charger render it of little use. A supply-line using a compact power transformer is described by which the entire circuit can be put into the body of a charging apparatus. The transformer core is 1.6 × 1.6 cm and the primary can be connected to 127 or 220 volts and has 5500 turns tapped at 3200. The secondary has 3200 turns. The resulting 120 volts goes to a doubling circuit and an electrolytic capacitor filter. (T.R.H.)

1536 NP-tr-481

A COINCIDENCE CIRCUIT USING TIME TO PULSE HEIGHT CONVERSION. (Circuit a Coincidence Utilisant la Conversion Temps-Amplitude.) S. Gorodetzky, Th. Muller, M. Port, G. Bergdolt, and J. Graff. Translated by A. J. Atkinson (U.K.A.E.A. Atomic Energy Research Establishment) from J. phys. radium 20, Suppl. No. 7, 49A-54A(1959). 21p. (Includes original, 6p.). JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 22306.

1537

AN AUTOMATIC CHANGER FOR LIQUID SAMPLES. H. de Waard (Natuurkundig Laboratorium Rijksuniversiteit, Groningen, Netherlands). Intern. J. Appl. Radiation and Isotopes 8, 139-41(1960) July. (In English)

The design and operation of an automatic sample changer for use with well-type scintillation counters are described. (C.H.)

1538

ON THE QUESTION OF MEASURING PROTON CURRENT. P. Goerlich (Gerlikh), Z. Keck (Ts. Kek), H. Krause (Kh. Krauze), A. Krohs (Kros), H. E. Pohl (Kh. E. Pol), and H. Schlott (Kh. Shlott) (Central Inst. of Nuclear Studies, Dresden and K. Zeiss Co., Jena, Ger.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 668-72(1960) June. (In Russian)

Proton beams with currents of 1×10^{-8} to 2×10^{-7} amps and with 6.7-Mev energy obtained from the Dresden Cyclotron were used to study the current response of scintillators and photoelements. The incident proton beam struck the following targets: a Faraday cup to measure the incident proton intensity, a monocrystal of CdS, a CsI (Tl) scintillator with photoelement, CsI (Tl) scintillator with selenium element type F, CdI (Tl) scintillator with a CdSe photoelement, and a selenium element type F. Graphs are given for the current response of each of these for various incident proton currents. The curves have the same general shape for both the direct bombardment of the photoelements and of the scintillators. These curves become nonlinear for the higher (2×10^{-6} amps) proton currents. Multiplication factors range from 34 to 180 for scintillator-photoelement respectively. The CdS monocrystal was a very highly sensitive and compact detector but its stability was not as good as that of the selenium photoelement. (TTT)

1539

AN INSTRUMENT FOR THE INVESTIGATION OF INTERPLANETARY PLASMA. H. S. Bridge, C. Dilworth, B. Rossi, F. Scherb, and E. F. Lyon (Massachusetts Inst. of Tech., Cambridge, Mass.). J. Geophys. Research 65, 3053-5(1960) Oct.

The instrument is designed to determine the density, direction, and magnitude of the bulk velocity of the protons of the interplanetary plasma. It is essentially a Faraday cup containing four grids which serve (a) to keep the electrons of the plasma from reaching the collector and (b) to suppress the photoelectric current by modulating the incoming protons without modulating the photoelectrons produced when the cup faces the sun. A transistorized electronic system amplifies, compresses, and demodulates the a-c signal from the collector before transmitting it to the telemetry system of the vehicle. Current densities from 10^{-12} to 10^{-8} amp/cm^2, and proton kinetic energies from 10 to 3000 ev, can be measured. (auth)

1540

A STUDY OF PULSE HEIGHT DISTRIBUTION OF BORON-TRIFLUORIDE PROPORTIONAL COUNTERS. Mikiya Yamane (Hitachi Central Research Lab., Tokyo). J. Phys. Soc. Japan 15, 1732-6(1960) Oct. (In English)

The pulse-height distribution of boron trifluoride counters under over-all irradiation by slow neutrons was treated allowing for the wall effect of the counter. Energy spectrum, $R(\epsilon')$, is given under assumption of a Gaussian resolution function by,

$$R(\epsilon') \approx \frac{s}{2RE_0}\int_0^{E_0}\frac{1}{\sqrt{2\pi\sigma}}\exp\left\{-\frac{(\epsilon'-\epsilon)^2}{2\sigma^2}\right\}d\epsilon + \left(1-\frac{S}{2R}\right)\frac{1}{\sqrt{2\pi\sigma}}\exp\left\{-\frac{(\epsilon'-E_0)^2}{2\sigma^2}\right\},$$

where s and E_0 are the whole range and initial energy of α particle, respectively, and R is the radius of the counter. Agreement between theoretical and experimental distributions is discussed for appropriate filling pressures. (auth)

1541

MAGNETIC PROBES OF HIGH FREQUENCY RESPONSE. S. E. Segre and J. E. Allen (Comitato Nazionale per le Ricerche Nucleari, Rome). J. Sci. Instr. 37, 369-71(1960) Oct.

Probes for the measurement of the magnetic field distribution in fast pulsed discharges were constructed. Their frequency response was measured and agrees well with that calculated from an equivalent circuit. The probes have an attenuation flat (to within 1%) up to 20 Mc/s. A criterion is given which states the optimum value for the impedance of the recording circuit. (auth)

1542

AUTOMATIC RANGE-CHANGING OF A LINEAR RATEME-

TER. S. Lovett (Microbiological Research Establishment, Porton, Wilts, Eng.). J. Sci. Instr. 37, 376-8(1960) Oct.

A circuit is described which automatically changes the range of a linear ratemeter as the count rate from a flow Geiger counter increases or decreases. The counter voltage is switched off when the count rate exceeds the maximum that the counter is designed to accept and is switched on at intervals to sample the count rate and remains on when the rate has diminished to an acceptable level. (auth)

1543

ELECTRONIC APPARATUS FOR THE STUDY OF X-RAYS WITH PROPORTIONAL COUNTER. N. Patla (Sir John Cass Coll., London). J. Sci. Instr. 37, 388-93(1960) Oct.

The design and construction of an electronic pulse recording system for use with a proportional counter suitable for x-ray studies are described. The performance of the high gain amplifier and pulse amplitude analyzer for x-ray wavelength discrimination is discussed in detail. (auth)

1544

THE USE OF VACUUM METERS TO THE LEAKAGE DETECTION IN INDUSTRIAL EQUIPMENT AND NUCLEAR POWER STATIONS. Aleš Blāha (Slovak Tech. Univ., [Bratislava]). Jaderná energie 6, 289-93(1960). (In Czech.)

A discussion is given of the principles of an instrument used as a leak detector, i.e., which would be sufficiently sensitive and simply designed, and which would react on the cooling medium of a heat exchanger. Thermal and ionization vacuum gages can meet these requirements. Mimimum leakage values detectable with these vacuum gages under different operational assumptions were derived. The sensitivities of vacuum meters are compared with other methods of leak detection. (auth)

1545

BETA ACTIVITY DETERMINATION OF LIQUID WASTES. František Běhounek (Czech Tech. Univ., Prague), and Vlasta Zelenková. Jaderná energie 6, 299-302(1960). (In Czech.)

The routine evaporation method of β activity determination in waste water with an end-window G-M tube was defined with more precision, and its sensitivity was improved. The introduction of double filtration measurements enabled the reliable β activity determination in a mixture of unknown radioisotopes with substantially different β spectra. This measurement enables also the qualitative determination of $Sr^{90} + Y^{90}$, i.e., of the radioisotopes with the strongest radiotoxicity. The method meets all requirements of hygienic rules of the Czechoslovak standard. (auth)

1546

AUTOMATIC CIRCUITS FOR RADIOACTIVITY MEASUREMENTS. Jiří Mackû (Charles Univ., Prague). Jaderná energie 6, 303-11(1960). (In Czech.)

All manual operations were changed to automatic in laboratory control and measurement practices. The basic types of automatic circuits used in foreign commercial instruments are considered. The advantages and disadvantages of these circuits are evaluated. (B.O.G.)

1547

MASS SPECTROMETRIC STUDIES OF CHEMICAL PROCESSES OCCURRING IN A SELF-QUENCHING GEIGER-MÜLLER COUNTER FILLED WITH LONG-CHAIN SATURATED HYDROCARBONS. I. Zlotowski and H. Wincel (Univ. of Warsaw). Kernenergie 3, 870-9(1960) Sept. (In English)

The kinetics of dissociation of n-pentane and n-hexane used as filling vapors in a self-quenching Geiger-Müeller counter was investigated. On the basis of numerous mass spectrometric data the rate law of the studied dissociation processes is essentially first order, except for very short initial periods with a much faster consumption of quenching parent molecules attributed to adsorption phenomena taking place on freshly outgassed electrode and glass surfaces. The decomposition rate constants and the specific electron yields for both n-pentane and n-hexane were evaluated; the respective numerical results are given. Curves are also presented to show what degree of correlation exists between the gradual decomposition of original hydrocarbon molecules and the operating characteristics of the counter. Finally, an attempt was made to analyze the effect of the chain length of the quenching hydrocarbons upon the rate and the mechanism of their decomposition in a Geiger-Müeller counter. (auth)

1548

A SIEGBAHN-EDVARSON TYPE IRONFREE DOUBLE FOCUSING BETA-RAY SPECTROMETER. C. De Vries and A. H. Wapstra (Inst. of Nuclear Research, Amsterdam). Nuclear Instr. & Methods 8, 121-45(1960) Aug. (In English)

An iron-free double-focusing β-ray spectrometer with 30-cm radius for precision energy and intensity measurements was constructed. It can be used for the focusing of electrons with an energy up to 2.6 Mev. The cooling system limits errors due to temperature effects to about one part in 10^5 in the relative $B\rho$-values of the electrons throughout the whole energy region. The long and short term stability of the coil current, delivered by a d-c generator, is in the order of $1:10^5$. External magnetic fields are compensated; fluctuations on the most important component of these fields are automatically suppressed to $<10^{-6}$ Wb/m^2. The field shape satisfies the conditions for first-order focusing in the radial direction and second-order focusing in the axial direction to a high degree: $\alpha = -0.500 \pm 0.003$ and $\beta = 0.39 \pm 0.02$. The maximum transmission is about 1%; the smallest linewidth obtained so far was 0.013%. (auth)

1549

IMPROVEMENTS IN THE FAST NEUTRON TIME OF FLIGHT TECHNIQUE USING PULSE SHAPE DISCRIMINATION IN AN ORGANIC PHOSPHOR. R. Batchelor, W. B. Gilboy, A. D. Purnell, and J. H. Towle (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods 8, 146-50(1960) Aug. (In English)

A very simple pulse-shape discriminator, based on the method suggested by Owen, was developed for the scintillation detector of a neutron time-of-flight apparatus. Almost complete cancellation of γ-ray pulses is obtained with the circuit adjusted to pass neutrons of energies >0.4 Mev. By discriminating against γ rays with the detector placed inside a large water shield, the random background was reduced by a large factor. The improvement obtained is illustrated with an inelastic neutron spectrum taken with iron at 4-Mev incident neutron energy. In this case the background reduction factor is between 5 and 10. (auth)

1550

AUTOMATIC APPARATUS FOR THE MEASUREMENT OF LOCAL GRADIENTS OF NEUTRON FLUXES IN A REACTOR. P. Mulot, R. Poussot, A. P. Schmitt, and C. P. Zaleski (Centre d'Études Nucléaires, Saclay, France). Nuclear Instr. & Methods 8, 185-94(1960) Aug. (In French)

An apparatus designed to measure strong gradients of neutron fluxes as may occur in nuclear reactors is described. Strips of material to be activated are exposed to the neutron flux and the induced β activity is measured as a function of position. The electronic and mechanical parts

of the apparatus are described; performance data are presented; and sample data are shown. (auth)

1551

CALCULATED SHAPES FOR NEUTRON BURSTS PRODUCED BY PHASED CHOPPER VELOCITY SELECTORS. Norman H. Tolk and Robert M. Brugger (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Instr. & Methods 8, 203-10(1960) Aug. (In English)

The burst shapes and transmission probabilities for neutrons passing through a phased chopper neutron velocity selector of the type now being used at the Materials Testing Reactor were calculated using an IBM-650 computer. Choppers with three types of slits (straight, parabolic, and circular) are considered and burst shapes are presented that show the operating characteristics of such velocity selectors. A function that gives a good fit to many of the burst shapes is presented. The results verify that a circular slit chopper can be used in place of the more exact parabolic slit chopper with only minor distortions in the operating ranges of interest. (auth)

1552

AN INSTRUMENT FACILITATING THE MEASUREMENT OF SMALL-ANGLE SCATTERING IN NUCLEAR EMULSION. A. G. C. Tenner, B. Jongejans, and H. Witteveld (Universiteit, Amsterdam). Nuclear Instr. & Methods 8, 221-4(1960) Aug. (In English)

The assembly of components constituting the instrument is described. Special attention is given to the essential features. The wiring diagrams are given. The experience obtained with the instrument in the first months of operation classifies it as a satisfactory new tool in nuclear physics. The principle underlying the instrument can be extended to bubble-chamber film. (auth)

1553

ON THE SEPARATION OF π^+ MESONS BY A TIME OF FLIGHT METHOD. G. M. Lewis, E. Gabathuler, and R. E. Azuma (The University, Glasgow). Nuclear Instr. & Methods 8, 230-2(1960) Aug. (In English)

A time analyzing coincidence unit of short resolving time was employed to separate photoproduced π^+ mesons from electrons and protons by a time-of-flight method. The positive pions are additionally identified by their decay characteristics, so that an assessment of the method as a mass discriminator can be made. (auth)

1554

A LOW BACKGROUND BETA COUNTER WITH A PLASTIC SCINTILLATOR ANTICOINCIDENCE SHIELD. J. R. Gat(Gutmann) and J. Gilat (Israel Atomic Energy Commission Labs.). Nuclear Instr. & Methods 8, 233-5(1960) Aug. (In English)

The design and performance of a low background β counter are described. The counter consists of a central gas flow proportional counter surrounded by a large plastic scintillator anticoincidence shield. (auth)

1555

A KILOVOLT, KILOAMPERE LOW PRESSURE SWITCH. George J. Brucker (Signal Corps Engineering Labs., Fort Monmouth, N. J.) and Kenneth C. Rogers. Nuclear Instr. & Methods 8, 236-8(1960) Aug. (In English)

A low-pressure switch is described which is capable of passing kiloamperes at voltages up to 30 kv. The effect of pressure and gap voltage on the switch closing time is discussed. (auth)

1556

A SCINTILLATION COUNTER SYSTEM FOR THE DETECTION OF POSITIVE AND NEGATIVE PIONS. J. G. Rutherglen and J. K. Walker (Univ. of Glasgow). Nuclear Instr. & Methods 8, 239-43(1960) Aug. (In English)

A three-counter telescope was developed in which pions are separated from particles of different mass by measurement of dE/dx and E. Identification of positive pions is made by means of the characteristic $\pi^+ - \mu^+$ decay. The arrangements for recording this information both photographically and by means of a pulse-height analyzer are described. (auth)

1557

THE THEORY AND OPERATION OF THE ROTATING CRYSTAL SLOW NEUTRON CHOPPER. D. A. O'Connor (Inst. of Nuclear Research, Warsaw). Nuclear Instr. & Methods 8, 244-8(1960) Aug. (In English)

The resolution and efficiency of the rotating crystal chopper are derived theoretically as a function of the crystal and collimator parameters. It is shown that the limiting resolution of the device is the same as that of a crystal monochromator. An experimental model chopper is described and its observed resolution compared with the theory. (auth)

1558

ON THE EFFECT OF CRYSTAL FORM ON THE ENERGY AND TIME RESOLUTION OF A SCINTILLATION ARRANGEMENT. G. Luck. Nuclear Instr. & Methods 8, 249-54(1960) Aug. (In German)

A decrease in the number of reflections of photons in a scintillation crystal leads to smaller fluctuations in time and pulse amplitudes of the output signal. This is possible with special forms of the scintillator. Mainly for great scintillator dimensions and high-particle energies this seems of some interest as one of the ways to raise the energetical and time resolution of a scintillation arrangement. (auth)

1559

IRON-FREE TOROIDAL BETA-BETA COINCIDENCE SPECTROMETER. Melvin S. Freedman, Frank Wagner, Jr., Fred T. Porter, John Terandy, and Paul P. Day (Argonne National Lab., Ill.). Nuclear Instr. & Methods 8, 255-8(1960) Aug. (In English)

The first half of an iron-free toroidal double β spectrometer, a version of the "sliced orange" design of Kofoed-Hansen et al., was completed and a description of the spectrometer design is given. It consists of two identical 100-turn 100-gap toroidal coils mounted 12 cm apart in a vacuum chamber and having the source mid way between them on their common axis. The β's emitted between 30 and 70° of the axis can be focused; the maximum energy is 3.5 Mev. The transmission and resolution of the first toroid is given. For β-β coincidence studies, the efficiency is improved by <100 at resolution ≤1%, and angular correlation measurements can be made at 45 to 180° with transmission ≥1%, β-γ coincidences and angular correlations, α-e^- coincidences, and triple coincidences can also be made. (D.L.C.)

1560

BANDWIDTHS OF THE EQUAL TIME-CONSTANT AMPLIFIER. J. B. S. Waugh (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Instr. & Methods 8, 257-8 (1960) Aug. (In English)

Formulas are developed for the effective noise bandwidths for amplifiers with both upper and lower pass band limits defined by equal RC time constants. The half-power or 3db bandwidth is found to be twice the center frequency; whereas the effective noise bandwidth is found to be proportional to the shot noise in addition to being dependent on the noise spectral distribution. Bandwidths are tabulated for the three most common types of noise distributions. (D.L.C.)

1561

A DOUBLE-DELAY-LINE LINEAR AMPLIFIER EMPLOYING TRANSISTORS. [PART] I. F. S. Goulding, R. W. Nicholson, and J. B. Waugh (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Instr. & Methods 8, 272-81 (1960) Sept. (In English)

A transistor amplifier designed mainly for precise scintillation counter spectroscopy is described. Techniques such as double-delay-line pulse shaping and considerable negative feedback result in excellent linearity, gain stability, and overload behavior at high counting rates. An input charge of 2×10^{-13} Coulombs develops a ±4 volt output pulse into a 100 Ω matched cable which feeds the Chalk River kicksorter. With 1 μsec pulse shaping lines, the input equivalent rms noise is 4000 ion-pairs. Lower noise may be achieved by using shorter lines. The amplifier rise time is 0.2 μsec (10 to 90%). Use of plug-in printed circuit boards increases the versatility of the amplifier and simplifies the adjustment procedures. (auth)

1562

A TRANSISTORIZED FAST-SLOW COINCIDENCE AND PULSE AMPLITUDE SELECTING SYSTEM. [PART] II. F. S. Goulding and R. A. McNaught (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Instr. & Methods 8, 282-96(1960) Sept. (In English)

A system developed for fast-slow coincidence experiments in nuclear physics is described, and the design of functional units including a low-level discriminator, single or dual-channel analyzer, coincidence circuit, and linear gate is discussed. The system is designed to use ±4 volt double-delay-line shaped pulses produced by a transistorized double-delay-line linear amplifier or equivalent pulses from other amplifiers. Operation with single-phase pulses of similar amplitude is also possible but with reduced performance. Uncertainty of the discriminator threshold and the spurious pedestal and disturbances introduced by the linear gate are <10 mv under all normal operating conditions. Functional units of the system are constructed on printed circuit boards which plug into a base unit where interconnections are made between them through a programming plug. This arrangement allows the experimenter to change interconnections quickly and makes the whole system extremely versatile. The system also takes advantage of the timing accuracy of the zero crossover of double-delay-line pulses to give a coincidence resolving time of 40 ns while using no fast amplifiers or coincidence circuits. A technique of compensating for baseline shift at high counting rates of single-phase pulses is also described. (auth)

1563

A VERSATILE, HIGH EFFICIENCY 4π NEUTRON DETECTOR. J. B. Marion, R. J. A. Levesque, C. A. Ludemann, and R. W. Detenbeck (Univ. of Maryland, College Park). Nuclear Instr. & Methods 8, 297-303(1960) Sept. (In English)

A high efficiency 4π neutron detector was constructed which consists of 12 $B^{10}F_3$ proportional counters imbedded in a 2-ft cube of paraffin. The response of this detector as a function of neutron energy was measured in the range 0.1 to 2.5 Mev by observing the yield curves for the T(p,n) and Li^7(p,n) reactions; the absolute total neutron production cross sections were accurately measured by Macklin and Gibbons. These measurements indicate a detection efficiency of ~10% and a response which is flat to within ±5% over the entire energy range studied. The efficiency for the detection of neutrons from a Ra-α-Be source (average neutron energy ~5 Mev) was found to be 6.5%. The efficiency was observed to decrease for neutron energies below about 0.1 Mev by measuring the yield from the V^{51}(p,n) reaction. The efficiency for the detection of 50-kev neutrons is ~4%. The detector was also used to detect neutron thresholds for nuclear ground states and excited states by observing the slow threshold neutrons in the forward direction with a LiI^6 scintillator surrounded by a B_4C shield. This "closed geometry" technique appears capable of only slightly less sensitivity than the "open geometry" method and is somewhat superior in energy resolution. (auth)

1564

THE SPHERICAL CONDENSER AS A HIGH TRANSMISSION PARTICLE SPECTROMETER. II. DISC SOURCE. R. D. Birkhoff, J. M. Kohn, H. B. Eldridge, and R. H. Ritchie (Oak Ridge National Lab., Tenn.). Nuclear Instr. & Methods 8, 313-19(1960) Sept. (In English)

The inverse square electric field between the plates of a charged spherical condenser provides a focusing of charged particles leaving a source on the inner sphere. Part I of this paper dealt with the characteristics of such a spectrometer for the case where the source may be considered concentrated at a point on the axis of the instrument. The present analysis is concerned with the line profile, the transmission, and the resolution of the spectrometer for a distributed source. Where high transmission is important, a source on the inner sphere having a radius 30% of the radius of the inner sphere provides a transmission of 16% at an energy resolution of 7.7%. (auth)

1565

A UNIVERSAL METHOD FOR THE STABILIZATION OF SCINTILLATION-SPECTROMETER-ARRANGEMENTS. S. Haun and D. Kamke (Universität, Marburg, Ger.). Nuclear Instr. & Methods 8, 331-8(1960) Sept. (In German)

The gain of a scintillation spectrometer can be held constant for long measuring times by including the spectrometer in a regulation circuit. All devices of this kind, which have been described as yet, are dependent on specific features of the spectrum and many situations arise where none of them can be used. The introduction of a pulsed source of light makes such stabilization devices universally applicable. This paper describes a light source and a suitable stabilization circuit with which a stability better than 0.5% was achieved for a 14-hr period, starting immediately after turning on the electronic circuits. The static and dynamic regulation properties are given as well as a method for evaluating all the effects due to the statistical character of the pulse height distribution produced by the light source and the photomultiplier. (auth)

1566

AN IMPROVED ANTI-COINCIDENCE SHIELD FOR USE IN LOW BACKGROUND COUNTING. R. P. Parker (Royal Cancer Hospital, London). Nuclear Instr. & Methods 8, 339-43(1960) Sept. (In English)

A liquid scintillator is used as an anticoincidence shield for eliminating the cosmic-ray component of the background of a Geiger-Mueller (G.E.C. Type GM 4 LB) counter. The apparatus is described and its performance compared with that of a shield of Geiger counters. A reduction in background from ~0.8 cpm (as measured with the Geiger shield) to ~0.45 cpm (as measured with the scintillator shield) was obtained. Evidence is presented which suggests that the reduction is due to the detection of cosmic ray-induced reactions in the material surrounding the counter. (auth)

1567

A NEW METHOD OF MASS DISCRIMINATION. G. Hrehuss (Central Research Inst. of Physics, Budapest). Nuclear Instr. & Methods 8, 344-7(1960) Sept. (In English)

Emission spectra of CsI(Tl) scintillation crystals bombarded by heavy as well as light particles were investigated. The results show the number of photons of shorter wavelength to be relatively higher in the case of excitation by light particles. This fact offers a new possibility for mass discrimination. (auth)

1568

AN IMPROVED INSTRUMENT FOR NUCLEAR EMULSION TRACK PHOTOMETRY. S. v. Friesen and B. Persson (Univ. of Lund, Sweden). Nuclear Instr. & Methods 8, 348-53(1960) Sept. (In English)

A description is given of a semiautomatic nuclear emulsion track photometer of high precision. (auth)

1569

SCINTILLATION COUNTERS. R. B. Owen (Atomic Energy Research Establishment, Harwell, Eng.). Nuclear Power 5, No. 54, 82-6(1960) Oct.

Tables are given for phosphors, photomultipliers, and scintillation-detector assemblies. Table 1 gives the principal physical properties, the forms available, and the names of suppliers for phosphors, and Tables 2 and 3 are arranged under manufacturers. The details were supplied by the manufacturers. (D.L.C.)

1570

AN APPARATUS FOR MEASUREMENT OF THE SURFACE AREA OF IRRADIATED COARSE POWDERS. F. D. Leipziger and L. A. Altamari (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng. 8, 312-14(1960) Oct.

An apparatus was designed for determining the surface area of highly radioactive coarse particles. The system uses krypton as the adsorbate and a thermistor manometer to measure pressures. Measurements were made on samples with areas as low as 50 cm^2. The design, construction, and precision of the system are discussed. (auth)

1571

TEMPERATURE CONTROL OF FUELED IRRADIATION CAPSULES BY VARIABLE CONDUCTANCE. W. W. Godsin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng. 8, 340-5(1960) Oct.

An irradiation capsule for high-temperature fuel irradiations was developed to permit constant temperature control over a range of about ±35% of design power. Control is achieved by the variation in thermal conductivity of a binary gas mixture in a control annulus located between the test specimen and the capsule coolant. For the binary mixture, helium, which is a high-thermal conductivity gas, and a gas of lower conductivity, such as neon, nitrogen, or argon, may be used. The control method is unaffected by time or radiation damage. In-pile operation of capsules using this method of control demonstrated that the desired temperature may be controlled to within ±25°F automatically, and probably more closely if manually controlled. The automatic control system also protects the capsule from temperature overshoot during a fast reactor recovery following a scram. (auth)

1572

RADIATION PROTECTION MEASUREMENTS IN MIXED NEUTRON FIELDS WITH PARAFFIN MODERATORS. W. Pohlit and H. Pohlit (Max-Planck-Institut für Biophysik, Frankfurt am Main). Nukleonik 2, 175-8(1960) Sept. (In German)

The utilization of moderated detectors for measuring neutron doses was reported. In the present study the relationship between the flux density of thermal neutrons at the interior of the moderator and the flux density or dose of fast neutrons at the surface is calculated. The calculations were made for paraffin moderators compared to water moderators. The calculated results were then compared with the results obtained experimentally using a BF_3 counter shielded by double paraffin layers. The results showed that the neutron flux density and the dose could be measured and an effective neutron energy could be determined. (J.S.R.)

1573

PULSING AN ION SOURCE AT HIGH FREQUENCY. Stefan Chwaszczewski (Inst. of Nuclear Research, Polish Academy of Sciences). Nukleonika 5, 355-60(1960). (In Polish)

The method of impulsing a Thonemann type ion source by a modulated h-f field is discussed. The application limits of this method were established. (auth)

1574

THE CHARACTERISTICS OF SCINTILLATION COUNTERS. Tomasz Radoszewski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 361-8(1960). (In Polish)

The plateau of a scintillation counter was checked, and its characteristics are described, including all influencing factors. A method is given for choosing and determining the proper parameters of a scintillation counter. (auth)

1575

THE CHARACTERISTICS OF A SOLID IRON MAGNET FOR USE IN A COSMIC RAY SPECTROGRAPH. P. V. O'Connor and A. W. Wolfendale (Univ. of Durham, Eng.). Nuovo cimento (10) 15, Suppl. No. 2, 202-10(1960). (In English)

Many advantages are gained by deflecting weakly interacting cosmic rays in magnetized iron instead of the conventional air gap of an electromagnet. A solid iron magnet was constructed in the form of a rectangular transformer core with excitation windings on opposite sides of the core. The design is based on the results of model experiments by Bennett and Nash on the variation of induction throughout the iron and the leakage field above and below the magnet. When the magnet is operated at a power of 2 kw (mean $\int Bdl$ = 982 kg cm), the variation of integrated magnetic induction for vertical particle trajectories is ±3%. (auth)

1576

TRIGGERED SPARK COUNTER ARRAYS OF LARGE AREA (SQUARE METERS) FOR EXPERIMENTS ON VERY HIGH ENERGY COSMIC RAY PARTICLES. N. B. Mistry, G. T. Murthy, P. V. Ramanamurthy, and B. V. Sreekantan (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 17, 429-37(1960) Aug. 1. (In English)

The constructional and operational features of triggered spark counters of large area are described. These counters are being used, in conjunction with nuclear emulsions, in current experiments on high-energy nuclear-interacting particles that arrive simultaneously over large areas, sometimes associated with air showers and at other times unassociated with air showers. For these experiments the spark counters and emulsions are being used in arrays covering an area of a few square meters. (auth)

1577

ON THE FIXING OF THICK NUCLEAR EMULSIONS. I. J. Van Heerden and J. G. McEwen (National Research Council of Canada, Ottawa). Nuovo cimento (10) 17, 671-7(1960) Sept. 1. (In English)

Rate of fixing, clearing time, swelling, and corrosion of Ilford G-5 and K-5 emulsions were studied for different fixing solutions under rigidly controlled conditions. Curves are given which may be used to predict when it is advisable to change some of the fixer. (auth)

1578

ELECTRON EMISSION IN IMAGE CONVERTER TUBES FOR γ-RAYS. P. V. Timofeev and V. V. Sorokina. Radiotekh. i Elektron. 5, 1687-91(1960) Oct. (In Russian)

Electron-optic converter tubes for γ rays, used in defectoscopy and medicine, are described and the cathode construction and properties are discussed. (tr-auth)

1579

MODIFICATION OF THE CHARGE DEVICE FOR DK-0,2 DOSIMETERS SUPPLIED BY ALTERNATING CURRENT MAINS. A. M. Medvedev, A. P. Vorontsov, and N. N. Mazovka (Kalinin Inst. of Medicine, USSR). Vestnik Rentgenol. i Radiol. 35, No. 4, 61(1960) July-Aug. (In Russian)

The scheme of a charging device supplied from 127 to 220 volts a-c current is described. A rectifier, with a semiconducting diode, is used. The charge current is about 300 volts. The illuminating tube is 6.3 volts. The transformer, condensers, and semiconducting diode are assembled on a 123 by 70 by 20 mm carriage. (R.V.J.)

1580

COMBINED RETARDING POTENTIAL ANALYSIS OF PHOTOELECTRONS AND ENVIRONMENTAL CHARGED PARTICLES UP TO 234 KM. H. E. Hinteregger (Air Force Cambridge Research Center, Bedford, Mass.). p.304-27 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

A retarding potential analyzer of parallel plane geometry was designed for three modes of operation to investigate photoelectric emission, environmental ions, and environmental electrons at the surface of space vehicles. The effective energy ranges of the instrument flown successfully to 234 km on Aug. 28, 1959, were 90 ev for photoelectrons, 4 ev for positive ions, and 100 ev for environmental electrons. The principle of operation is discussed, and preliminary results of the first flight experiment are presented. (auth)

1581

A PROBE FOR MEASURING ION DENSITY IN THE IONOSPHERE. T. Ichimiya and K. Takayama (Nippon Telegraph and Telephone Public Corp., Tokyo), and Y. Aono. p.397-416 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

In the measurement of positive-ion density in the ionosphere with a rocket-borne probe, the principal disturbing effect is produced by the photoelectric current emitted from the probe by solar ultraviolet radiation. A small meshed spherical probe was proposed to overcome this effect. The characteristics of a probe formed by crossing two rings, 4 mm in diameter, of tungsten wire, 0.1 mm in diameter, were examined. The ion densities obtained agree with those obtained with a cylindrical probe 15 mm long, 0.38 mm in diameter, within the range of 1.8×10^5 to 3×10^6 ions per cubic centimeter. A simple rocket-borne cathode follower circuit amplifier was constructed for the measurement of the positive-ion density in the ionosphere with the double probe method. The total weight of the amplifier is 1.4 kg. Shock tests up to 100 g did not affect the instrument. (auth)

1582

ELECTRICAL CONNECTION ASSEMBLY. Bernard Downhill (to United Kingdom Atomic Energy Authority). British Patent 849,748. Sept. 28, 1960.

Electrical connection assemblies may be easily made by jamming two malleable wires in a hole in a rigid electrically conducting material with a ball bearing of diameter smaller than that of the hole. The assembly may then be cemented with an epoxy resin to secure the connection. (D.L.C.)

1583

IMPROVEMENTS IN OR RELATING TO CIRCUITS FOR SAMPLING OSCILLOSCOPES. George Brian Barrie Chaplin, Alwyns Roberts Owens, and Charles James Nowell Candy (to United Kingdom Atomic Energy Autnority). British Patent 850,700. Oct. 5, 1960.

A transistorized time-base circuit with a transistor connected in a trigger circuit is designed for sampling oscilloscopes for pulses having rise times of the order of 1 nanosecond. The advantage of this circuit is that transistors operated in the avalanche mode produce fast edges and narrow pulses; thus sampling oscilloscopes of small size, low cost, and low power consumption may be constructed. (D.L.C.)

1584

IMPROVEMENTS IN OR RELATING TO SCINTILLATION COUNTERS. John Nigel Illingworth Evans (to E. K. Cole Ltd.). British Patent 851,310. Oct. 12, 1960.

The energy resolution of a scintillation counter may be improved by making the NaI(Tl) crystal spherical or spheroidal in form, roughening its surface, and surrounding it with a white reflecting powder (e.g., aluminum oxide or magnesium oxide) except at the part which is coupled to a photomultiplier. In this way, the light reaching the photomultiplier cathode is rendered less dependent on the scintillation position in the crystal. (D.L.C.)

1585

IMPROVEMENTS IN OR RELATING TO THE SELECTIVE DETECTION OF FISSION PRODUCTS IN A GAS FLOW. (to Commissariat à l'Énergie Atomique). British Patent 851,328. Oct. 12, 1960.

A device is invented for selectively detecting short-lived fission products in a gas flow without the disadvantages of known detectors. A configuration is presented for detecting burst slugs in a graphite-moderated, CO_2-cooled reactor and comprises a decay prechamber, a detection chamber downstream from the prechamber, and detection means for determining the radioactivity in the chamber. In operation, a gas flows from the main duct into the prechamber, where the short-lived fission products decay to radioactive ions, and then into the chamber. A phosphor-photomultiplier assembly located outside a window in the chamber detects the general gas activity. After 30 sec, the valves are closed, isolating the gas inside the prechamber and chamber, and the rubidium and cesium ions resulting from decay in the prechamber are attracted to an electrode in the chamber. The photomultiplier assembly then detects the general gas activity increased by the activity of the ions collected on the electrode. After radioactive particles of long life have accumulated on the electrode, it may be easily replaced; for the given configuration, it is sufficient to replace electrodes every 1000 hr. One advantage of this device is the absence of moving parts. (D.L.C.)

Materials Testing

1586 SCTM-205-60(12)

Sandia Corp., Albuquerque, N. Mex.

WAVEFORM EFFECTS IN SHOCK TESTING. W. J. Sieger. Aug. 22, 1960. 24p. OTS.

Curves are presented to furnish a means of comparison between the effects of the idealized semisinusoidal acceleration pulse frequency specified in dynamic-test criteria and numerous actual acceleration pulses recorded on Sandia shock-test facilities. These curves are designed to aid in finding an equivalent acceleration magnitude which, when used on a particular test facility, will produce either the same peak primary or residual response of the component as would be obtained if the test facility were capable of producing a true semisinusoidal pulse. The degree of accuracy involved depends largely on the dynamic similarity of the component in question and a simple oscillatory system with no damping; however, the method reported may be extended to encompass more complex systems. (auth)

1587 WADC-TR-59-412
Illinois. Univ., Urbana.
NONDESTRUCTIVE TESTS FOR CERAMIC, CERMET AND GRAPHITE MATERIALS. Period covered: July 1, 1958 to June 30, 1959. Julian H. Lauchner, Dwight G. Bennett, and George L. Morgan. June 1959. 63p. Project No. 7360. Contract AF33(616)-5687. (AD-236674).

Nondestructive testing methods were evaluated for ceramic, cermet, and graphite materials. In general, radiographic techniques and fluorescent penetrant inspection were found applicable to detect internal and surface flows, respectively. The state of residual stress existent in a body was found to be a first order factor in predicting performance. Thermal expansion, elastic moduli, shape factors, and heat treatment were employed in the development and analysis of residual stress levels. The change in apparent specimen strength was found to be a direct function of the residual stress in the surface layer; however, limiting factors such as the internal-stress critical-value, characteristic of a body, were found. Thermal treatment studies indicated that body density, resulting from body forming techniques or firing schedules, was a measure of body maturity and general freedom from macroscopic defects. (C.J.G.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

1588 NP-9166(p.217-21)
Indian Inst. of Science, Bangalore.
GEOCHRONOLOGY AND MASS SPECTROMETRY. (Review). R. S. Krishnan.

A review is presented on the isotopic-abundance methods of geochronology such as lead-uranium-thorium, potassium-argon, and strontium-rubidium methods. (D.L.C.)

1589 NP-9166(p.222-4)
Indian Inst. of Science, Bangalore.
INVESTIGATIONS ON ISOTOPE ABUNDANCES OF ALKALI ELEMENTS. V. S. Venkatasubramanian.

The abundance ratios K^{39}/K^{41} and Li^7/Li^6 were determined for a number of minerals using a mass spectrometer with a two-filament source proposed by Inghram et al. to eliminate isotope-discrimination effects; the source comprises a central tungsten filament and a side platinum filament. The K^{39}/K^{41} ratio for about a dozen specimens of microcline, plagioclase, muscovite, biotite, and lepidolite was observed to be within the range 13.85 to 13.92, i.e., no variation was observed in the ratio within the experimental error. The Li^7/Li^6 ratio for two spodumene specimens and one lepidolite specimen was found not to vary from the average value of 12.50 within limits of error. (D.L.C.)

1590 TID-6482
Arizona. Univ., Tucson. Geochronology Labs.
CORRELATION AND CHRONOLOGY OF ORE DEPOSITS AND VOLCANIC ROCKS. Annual Progress Report No. 2. Paul E. Damon, William D. Green, Carroll J. Halva, and Bruno E. Sabels. July 1, 1960. 114p. Contract AT(11-1)-689. OTS.

The construction of the 60° 6-in. first-order single-focusing mass spectrometer was completed. The design and operation of the trochoidal mass spectrometer, consisting of a CEC Diatron 20 modified for degassing at up to 400°C, are described. The research effort on ore deposits was concentrated on two major problems which must be solved before precise and accurate dates may be obtained by the helium method using magnetite as the geochronometer. It was necessary (1) to define the location of uranium and thorium in magnetite and (2) to accurately determine the uranium/thorium ratio as well as the total rate of α emission. Acid-leaching experiments and radio-autography were used to determine the location of uranium and thorium in magnetite. Fluorimetric analysis and γ-ray spectroscopy were employed to determine the uranium/thorium ratio. Various techniques for correlating volcanic rocks were investigated. These include chemical and radiometric as well as petrographic and field techniques. The Plio-Pleistocene basalts of southeastern Arizona and the San Francisco volcanic field and adjacent areas were investigated. (W.L.H.)

1591
CRYSTAL CHEMICAL STUDIES OF SOME URANYL OXIDE HYDRATES. C. L. Christ and Joan R. Clark (U. S. Geological Survey, Washington, D. C.). Am. Mineralogist 45, 1026-61(1960) Sept.-Oct.

Mineralogical and crystal-chemical studies were made of the closely related uranyl oxide hydrates becquerelite, billietite, fourmarierite, masuyite, schoepite, and vandendriesscheite. An essential feature of the work is the use of x-ray precession techniques with carefully selected single crystals to determine accurately the crystallographic constants, the symmetry, and the structural relations of these minerals. Indices of refraction and optical orientation were determined on crystals both identified and oriented by the x-ray precession method. Similarly identified crystals were used to obtain the indexed powder pattern data listed. The results obtained on the physical properties, the x-ray crystallography, the x-ray powder data, and the optical properties are listed and compared with the work of other investigators in the 23 tables of the paper. Crystals of schoepite and of vandendriesscheite that are apparently single actually consist of several crystallographically distinct phases in parallel intergrowth. The spontaneous alteration from one phase to another that occurs in these crystals results from loss of water of hydration. All six of the minerals studied yield strikingly similar pseudohexagonal diffraction patterns. A reasonable crystal structure based on these patterns consists of $UO_2(OH)_2$ layers (similar to those proved by Zachariasen to exist in UO_2F_2) parallel to the perfect cleavage (001), with the water of hydration and any cations present in interlayer positions. (auth)

1592
RANQUILITE, A CALCIUM URANYL SILICATE. M. Jiménez de Abeledo, María Rodríguez de Benyacar, and Ernesto E. Galloni (Comision Nacional de Energía Atómica, Buenos Aires). Am. Mineralogist 45, 1078-86 (1960) Sept.-Oct.

A new uranium mineral, ranquilite, was found in Mendoza

Province, Argentina. The probable formula is $1.5CaO \cdot 2UO_3 5SiO_2 \cdot 12H_2O$. The orthorhombic unit cell has $a_0 = 17.64$ A, $b_0 = 14.28$ A, and $c_0 = 18.48$ A; Z = 8; and G = 3.32. Samples heated at 110 to 120 and 130 to 140°C show certain changes in the x-ray powder pattern suggesting two lower hydrates. After exposure to the air, the original pattern is again obtained. (auth)

1593

FURTHER X-RAY POWDER STUDIES ON SYNTHETIC LOWER HYDRATES OF SALEEITE. Augusto Baptista (Instituto de Óleos, Rio de Janeiro). Anais acad. brasil. cienc. 32, 31-4(1960). (In English)

By heating at 150°C, synthetic saleéite transforms into an orthorhombic phase with cell dimensions $a_0 = 6.44$ A, $b_0 = 6.94$ A, and $c_0 = 8.41$ A. The rehydration of this substance led to another phase, the powder data of which could be indexed both as a tetragonal cell ($a_0 = 6.95$ A, $c_0 = 8.76$ A) and as an orthorhombic cell ($a_0 = 6.50$ A, $b_0 = 6.95$ A, $c_0 = 8.76$ A). Calculations based on a partial chemical analysis seem to indicate that this compound is a hexahydrate. From laboratory results and from literature reference, it is likely that the $A(UO_2)_2(PO_4)_2 nH_2O$ compounds can become orthorhombic or tetragonal as the number of water molecules varies; this process is reversible. (auth)

1594

STREAMING POTENTIAL STUDIES ON A URANIUM OXIDE MINERAL. H. C. Parreira and R. H. Ottewill (Comissão Nacional de Energia Nuclear, Rio de Janeiro and Cambridge Univ., Eng.). Anais acad. brasil. cienc. 32, 35-42 (1960). (In English)

The construction of a useful form of streaming potential cell is described. The cell is used to investigate the changes in zeta potential of two samples of uranium oxide mineral as a function of pH and potassium chloride concentration. The mineral was found to possess ionogenic groups on the surface with weakly acidic properties at neutral pH. (auth)

1595

GEOLOGICAL AND RADIOMETRIC EXAMINATION BETWEEN CASMA AND CULEBRAS. DEPARTMENT OF ANCASH. Bol. inform. junta control energía atómica (Peru) 5, 31-8(1960) July-Aug. (In Spanish)

A geological and radiometric study was made of the coast between Casma and Culebras in the Huarmey Province, Ancash Department. The only mineralization found was at the Adan Mine and consisted of copper, iron, and rare minerals. The highest abnormal radiometric readings were found in the rare minerals. The geology of the region is described generally. (J.S.R.)

1596

EXTRACTABILITY OF HUMIC ACID FROM COALIFIED LOGS AS A GUIDE TO TEMPERATURES IN COLORADO PLATEAU SEDIMENTS. Irving A. Breger and John C. Chandler (U. S. Geological Survey, Washington, D. C.). Econ. Geol. 55, 1039-47(1960).

Coalified logs in Triassic and Jurassic sediments of the Colorado Plateau were exposed to alkaline ground water. Extraction of humic acids under such conditions is temperature dependent. Study of residual humic acids in a suite of coalified logs has indicated that temperatures up to 120°C prevailed in the sediments. This maximum temperature corresponds with that to be expected from geothermal gradient and estimated from mineralogic evidence. (auth)

1597

ISOTOPIC COMPOSITION OF LEAD IN SEDIMENTARY U-BEARING MINERALIZATIONS. G. Ferrara (Comitato Nazionale per le Ricerche Nucleari, Pisa, Italy), D. Ledent, and H. Stauffer. Helv. Phys. Acta 32, 279-82(1959). (In German)

The isotopic composition of lead and the age of some Italian (Western Alps) and Swiss (Gran S. Bernardo) uranium minerals were determined by the RaD method. For the samples from the Western Alps the average value confirms the hypothesis of the contemporaneity of the mineralization with the sedimentation during the Permian time. The age values found in the Swiss samples indicate a secondary deposition of uranium minerals. (auth)

1598

GEOPHYSICAL EFFECTS INDUCED BY HIGH-ALTITUDE ATOMIC EXPLOSIONS. V. A. Troitskaya (Geophysics Inst., Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz. No. 9, 1321-7(1960) Sept. (In Russian)

Preliminary results are presented from an analysis of the oscillations induced in the earth's magnetic field by high-altitude atomic explosions in the South Atlantic (operation "Argus") and in the vicinity of Johnston Island in the Pacific Ocean. Recordings taken at the Arctic and Antarctic were used in the analysis. (tr-auth)

1599

RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT IN THE CINCINNATI AREA. Lloyd R. Setter and Helen H. Russell (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Am. Water Works Assoc. 51, 449-62(1959) Apr.

In 1957 the annual fall-out in the Cincinnati, Ohio, area amounted to 15,200 $m\mu c/m^2$. The samplings included rain collected at various places over the city, tap water from six cisterns, surface water from local streams, and particles from air caught on membrane filters. A large portion of the fall-out was young fission products, from two to five days old. The cistern water contained an average of 630 $\mu\mu c$/liter of gross β activity. Stream-water samples from three rivers in southwest Ohio contained an average of 70 $\mu\mu c$/liter. The estimated amount of Sr^{90} in the precipitation was 10 $\mu\mu c$/liter or one-eighth of the permissible level. A summary of fall-out studies since Mar. 1953 is also included. (M.C.G.)

1600

DEPOSITION OF RADIOACTIVE DUST AND ATMOSPHERIC CONDITIONS. Takeshi Sotobayashi and Seitaro Koyama (Niigata Univ., Japan). J. Fac. Sci. Niigata Univ., Ser. I, 2, 121-35(1960).

There are two processes for causing the deposition of the artificial radioactive dust. First, a process in which the dust is transported from the stratosphere and the upper troposphere where the most part of dust resides to the middle or lower troposphere where condensation and precipitation mainly occur, second, a process in which the dust is captured as nuclei of cloud particles and in collision with raindrops in the middle and lower layer of the troposphere. In the first process, the effect of increasing the air concentration of dust owing to the downward component of upper air flow is considered. In the middle latitudes this effect is closely related with the atmospheric condition of whether or not a trough of the long wave in the westerlies exists over an observation point. In the latter process, the deposition of the dust is affected markedly by the air concentration of radioactive dust in the layer where condensation and precipitation occur and the total traveling range of raindrops through the air mass which contains the radioactive dust. In regard to the meteorological conditions related with this process, the important factors are the rela-

tive position of an observation point to the path of an extratropical cyclone and the type of rain. (auth)

1601

STRATOSPHERIC MIXING FROM RADIOACTIVE FALL-OUT. W. F. Libby and C. E. Palmer (Univ. of California, Los Angeles). J. Geophys. Research 65, 3307-17(1960) Oct.

The radioactive fall-out during 1959 shows that the Russian October 1958 debris dominated the northern hemisphere and came down with a residence time corresponding to about 8 months. The rest of the world had a steady fall-out rate of about 0.06 mc/mi^2/in. of rain throughout the year, whereas values for the northern hemisphere came down to this value in the months of September, October, and November when the Russian debris was apparently exhausted. Thus, it appears that there is a world-wide fall-out rate of about 0.06 mc/mi^2/in. of rain which is nearly independent of the Russian polar debris and which is probably from the equatorial tests. Using the estimate of the amount of material injected into the stratosphere, this world-wide rate of fall-out corresponds to a residence time of about 5 years for equatorial injections. Goldie suggested that the meridional circulation at levels well within the stratosphere consists of an up-welling of air at the equator, followed by a polar flow, a down-welling in the polar region, and an equatorward movement above the troposphere at approximately 24 km. In addition, a seasonal perturbation of this circulation occurs in the long winter night near the pole. It results in an accumulation of material at high levels near the pole, until the sun returns in the spring, when a sudden break-up occurs and the material is rapidly carried toward the troposphere. This model explains quite well most of the present observations on radioactive fall-out. The polar debris would naturally have a shorter residence time because it would be introduced in the last steps of the cycle, the equatorial would have a longer residence time, having been introduced at the beginning of the cycle, and the spring breakup of the polar vortex would account for the well-known spring maximum in the rate of radioactive fall-out. The residence times of material injected near the equator and the pole, respectively, permit a quantitative estimate of the intensity and depth of the circulation to be made. The meridional velocity deduced for the equatorially directed low stratospheric current is about 1 to 3 miles per hour, whereas that for the poleward high stratospheric current is about one-tenth as large. This requires, of course, that 90% of the stratospheric air be concentrated in the high band. (auth)

1602

RADON FLUX AT THE EARTH-AIR INTERFACE. Marvin H. Wilkening and John E. Hand (New Mexico Inst. of Mining and Tech., Socorro). J. Geophys. Research 65, 3367-70(1960) Oct.

A radon condenser utilizing a trap cooled by liquid oxygen was used to measure the radon content of the atmosphere and of the soil gases escaping through the surface of the earth. The average atmospheric-radon concentration at ground level in the Socorro area was found to be 0.24×10^{-12} curie/liter, and a measurement of the radon flux at the earth-air interface gave a result of 90×10^{-18} curie/cm^2/sec. The radon content of the air showed a diurnal fluctuation, whereas the radon flux at the earth-air interface appeared to be relatively constant over a diurnal period. Diffusion theory is used to derive an expression for the radon flux in terms of the concentration of radon in the soil at depth. The flux value measured is consistent with a concentration of radon produced by 1.1×10^{-12} g of radium per gram of soil. (auth)

1603

AN EQUATION FOR ESTIMATING TRANSMISSIBILITY AND COEFFICIENT OF STORAGE FROM RIVER-LEVEL FLUCTUATIONS. P. P. Rowe (General Electric Co., Richland, Wash.). J. Geophys. Research 65, 3419-24(1960) Oct.

An equation was derived from which transmissibility and coefficient of storage of an aquifer can be estimated. A linear change with time of the depth of a nearby surface body of water was assumed in the derivation. A laboratory model was used to test the applicability of the equation under the conditions assumed in the derivation. The values of T/S calculated from this equation were compared with the value of T/S estimated from data obtained under steady-state conditions. The agreement between these values was fair. The equation seems to be accurate when the boundary conditions are satisfied. (auth)

1604

SEISMIC WAVES FROM HIGH-ALTITUDE NUCLEAR EXPLOSIONS. Paul Pomeroy and Jack Oliver (Lamont Geological Observatory, Palisades, N. Y.). J. Geophys. Research 65, 3445-57(1960) Oct.

Seismic waves of long period were well recorded at epicentral distances as great as 9300 km from two high-altitude nuclear explosions, Teak and Orange, which were fired in the Johnston Island area on August 1 and 12, 1958, respectively. Seismic waves recorded at Honolulu, at a distance of approximately 1300 km, may be divided into three types: (1) a normally dispersed, oceanic Rayleigh wave train in which the wave periods decrease from about 35 to 14 sec as the corresponding velocities decrease from about 4.1 to 1.6 km/sec; (2) an inversely dispersed, oceanic Rayleigh wave train in which the wave periods increase from about 6 to 10 sec as the corresponding velocities decrease from about 1.3 to 1.0 km/sec; (3) a T-phase consisting of waves with periods less than about 0.5 sec and corresponding to a velocity of 1.47 km/sec. From the normally dispersed train, group velocities of waves in the 35- to 14-sec period range were computed for the two paths, both of which traverse primarily a typical deep oceanic basin. These group-velocity data plus possible corresponding phase-velocity data are compared with theoretical values for oceanic structures. The inversely dispersed train, although predicted by classical theory, has not been observed in seismograms from (natural) earthquakes. Surface waves of long period were recorded at Palisades, New York, from both of the high-altitude nuclear explosions, and these waves have amplitudes comparable to those generated by the larger of the near-surface explosions in the Marshall Islands. Special instruments at Palisades, not operated for Teak, indicate that amplitudes for the long-period body waves from Orange are comparable to those from the Marshall Islands shots. In contrast, seismic body waves of short period are apparently generated much more efficiently by near-surface explosions than by high-altitude explosions. (auth)

1605

OBSERVATIONS OF THE TEMPORARY PRESENCE OF RADIOACTIVE MATTER IN THE ATMOSPHERE. C. D. Anger and R. R. Brown (Univ. of California, Berkeley). J. Geophys. Research 65, 3502-3(1960) Oct.

Winckler described two observations of radioactive layers in the atmosphere resulting from nuclear explosions. Two similar observations were made in a series of balloon flights in September and October 1958. In contrast to the observations of Winckler, the radioactive matter observed here extended to atmospheric levels well above the 15 cm Hg pressure level. On both occasions the intensity ob-

served at the 5.5 cm Hg level was 4 to 5 cps above normal. If it is assumed that the shielded counter mainly responded to γ rays of 1 Mev, this corresponds to a specific activity of ~3 disintegrations/g-sec at this atmospheric depth. Both the ascent and descent portions of the flights showed comparable radiation levels in the atmosphere in excess of expected cosmic radiation. (B.O.G.)

1606

THE MEASUREMENT OF WINDS BETWEEN 100,000 AND 300,000 FT BY USE OF CHAFF ROCKETS. Lawrence B. Smith (Sandia Corp., Albuquerque, N. Mex.). J. Meteorol. 17, 296-310(1960) June.

During July and August 1958, 20 wind observations were made at altitudes of 100,000 to 300,000 ft at Johnston Island in the Pacific Ocean. Three observations were made at Tonopah, Nevada, in May 1958. These measurements resulted from radar tracking of chaff expelled from rockets. A height profile of the measured winds is presented, and a description of the two-stage rocket-delivery system is given. Observed winds were predominantly and consistently easterlies with average speeds near 75 knots. Little change with altitude was noted, although there are indications of reversal of direction to westerlies above 300,000 ft. System errors are discussed. An attempt is made to determine 12- and 24-hourly periodicities in these data; results are inconclusive because of data scarcity. (auth)

1607

INCREASE IN THE RADIOACTIVITY OF FALLOUT IN CONSEQUENCE OF NUCLEAR TESTS IN THE SAHARA DESERT. Vilém Santholzer (Charles Univ., Prague). Jaderná energie 6, 294-8(1960). (In Czech.)

The first nuclear test in the Sahara [Feb. 13, 1960] manifested itself in Hradec Králové [Czechoslovakia] by an increase in the radioactivity of the fall-out on the days from Mar. 1 to 20, 1960. The second Sahara test [Apr. 1, 1960] increased radioactivity of the fall-out from Apr. 8 to 15, 1960. Maximum radioactivity following the first test was recorded on Mar. 1 and 2, reaching 17.65 mc/cm^2/day. After the second test the amount was only 0.70 mc/cm^2/day. Temporal decrease in activity is dependent on the relation $A = at^{-n}$, where a is a constant, t = time counted from the date of the nuclear test. The exponent n is 1.2 to 1.4; the activity of dry residues of rain precipitations is 1.2. Graphic proofs were made that the date of origin of March activities is Feb. 13, 1960, and that of the April activities is Apr. 1, 1960, which corresponds with the dates of the test explosions in the Sahara. (auth)

1608

A STUDY OF THE RELATIVE ABUNDANCE RATIO OF ISOTOPES ^{32}S AND ^{34}S IN SOME POLISH NATIVE SULPHUR DEPOSITS. I. Zlotowski and A. Stroka (Univ. of Warsaw). Kernenergie 3, 879-83(1960) Sept. (In English)

The relative abundance ratios of two sulfur isotopes, S^{32} and S^{34}, in recently discovered Polish native sulfur deposits of Tarnobrzeg, Grzybow, Lubaczow, and Trusze near Horyniec (shaft No. 3; 132.6 m below ground level) were determined using a Nier type mass spectrometer. The over-all error in the isotopic ratio determinations was <1%. The isotopic constitution of sulfur extracted from pure marine sulfates was used as reference standard. The determined S^{32}/S^{34} ratios in five specimens of Polish native sulfur were compared with the corresponding values found by other authors for native sulfur of various origins. A brief discussion of possible correlation between the established S^{32}/S^{34} ratios and the geological data regarding the studied native sulfur deposits was presented. (auth)

1609

TUNGSTEN-185 IN PRECIPITATION AND THE SEASONAL VARIATIONS IN FALL-OUT. A. Walton (Isotopes Inc., Westwood, N. J.). Nature 188, 220-1(1960) Oct. 15.

The introduction of tungsten during the U. S. "Hardtack" nuclear test series provided a unique opportunity for identifying nuclear debris of known origin. From June 1958 to August 1959, 74-day W^{185} was detected in precipitations. The deposition of W^{185} and Sr^{90} in precipitation at Westwood, N. J., is shown graphically, together with the amount of rainfall. All of the tungsten results were corrected for decay to August 15, 1958. A similar graph is given showing the variations of specific activity of Sr^{90} and W^{185} in rainfall from June 1958 to July 1959. The W^{185} to Sr^{90} ratio is plotted as a function of time over the same period. The W^{185} data demonstrated that material injected into the stratosphere in the equatorial regions is involved in the seasonal variations of fall-out. (B.O.G.)

1610

SPECTRUM OF RADIATION BACKGROUND UNDER WATER. Gordon K. Riel, John P. Dolfis, and Donald G. Simons (Naval Ordnance Lab., White Oak, Md.). Nature 188, 266-8(1960) Oct. 22.

An analysis was made of the radiation background under water with a scintillation spectrometer consisting of NaI(Tl) crystal and a transistorized 128-channel analyzer for pulse-height sorting. The spectral results showed essentially three major energy peaks at 1.46, 2.6, and 3.3 Mev, and two minor peaks at 1.8 and 2.2 Mev. The peak at 1.46 Mev, K^{40}, was the most prominent. The peak at 2.6 Mev corresponded to the 2.61-Mev γ ray from Tl^{208} in the natural Th^{232} chain. The peak at 3.3 Mev was found to be present as a contaminant in the steel pressure vessel and not in the water. (M.C.G.)

1611

THE URANIUM MINING INDUSTRY IN FRANCE AND IN THE WORLD. Jean Lecoq (Commissariat à l'Énergie Atomique, [Saclay, France]). Nucleus (Paris) No. 3, 184-95(1960) May-June. (In French)

After discussing generalities such as raw materials problems and requirements of the nuclear industry, a treatment is given to prospecting, exploitation of uranium deposits, concentration of uranium ores, and economic aspects of the uranium mining industry. The discussion involves the more specific topics of choice of regions for prospecting, radiometric prospecting on the ground, aerial prospecting, radiometric equipment, geochemistry, geophysics, knowledge of deposits, statistics applied to mines, character of uranium mines, and protection against radioactivity. (T.R.H.)

1612

ON THE RADIOACTIVITY AND PARTICLE ANALYSIS OF AIRBORNE DUST IN THE TROPOSPHERE. N. Yano and H. Naruse (Meteorological Research Inst., Tokyo). Papers Meteorol. and Geophys. (Tokyo) 11, 9p.(1960). (In English)

The radioactivity and particle size of fall-out materials in the troposphere were investigated. Aircraft observations were made at heights to 7 km. The technical problems involved in sampling and measurements and the vertical distribution of the gross activity are discussed. The vertical concentration and size distribution at each height are given. Results indicated that radioactivity increased exponentially with altitude. The concentration of particles of larger size was found to decrease exponentially with height in a clear sky. The concentration of larger size particles was found to decrease in clouds also. (M.C.G.)

HEALTH AND SAFETY

1613 AHSB(RP)R-2

Gt. Brit. Agricultural Research Council. Radiobiological Lab., [Grove], Berks, England and United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England.

THE DEPOSITION OF STRONTIUM 89 AND STRONTIUM 90 ON AGRICULTURAL LAND AND ITS ENTRY INTO MILK AFTER THE REACTOR ACCIDENT AT WINDSCALE IN OCTOBER 1957. F. B. Ellis, H. Howells, R. Scott Russell, and W. L. Templeton. July 1960. 36p. BIS.

1614 FFIF-IR-F-397

Denmark. Forsvarets Forskningsråd, Copenhagen; Norway, Forsvarets Forskningsinstitutt, Oslo; Sweden. Forsvarets Forskningsanstalt, Stockholm; and Sweden. Kungliga Karolinska Medico-Kirurgiska Institutet. Radiosysiska Institutionen, Stockholm.

PHYSICAL ASPECTS OF THE RADIOACTIVE FALLOUT OVER SCANDINAVIA ESPECIALLY DURING THE PERIOD OCTOBER 1958–OCTOBER 1959. Jan. 1960. 46p.

Data are summarized on fission-product activity during the period from October 1958 to October 1959. Measurements of airborne activity were made both above and below the tropopause layer. The effects were studied of heavy stratospheric injections from nuclear tests during 1958, after a year free from nuclear tests. It was estimated that about 40 megatons of total fission energy was released during 1958. About 20 megatons were released during the tests in the Arctic during September and October, 1958. The measured abundance of various nuclides indicates that the bulk of the heavy fall-out over Scandinavia was injected during October 1958. Data are tabulated. (C.H.)

1615 NP-9004

Sweden. Försvarets Forskningsanstalt, Stockholm and Sweden. Kungliga Karolinska Medico-Kirurgiska Institutet. Radiofysiska Institutionen, Stockholm.

COMMUNICATION ON RADIOACTIVITY LEVELS OBSERVED IN SWEDEN AS A RESULT OF NUCLEAR WEAPONS TESTS. Nov. 3, 1959. 27p.

The radioactivity in Sweden as a result of the September to October, 1958 nuclear tests was found to have decreased. The concentration of long-lived fission products reached a maximum about 6 months after the tests and then declined to relatively low values. Investigations of the radioactivity in milk were made on dry milk from the years 1955 to 1959. The values obtained suggested an annual increase in the amount of cesium-137 and strontium-90 present. (M.C.G.)

1616 NP-9138

Sweden. Kungliga Karolinska Medico-Kirurgiska Institutet. Radiofysiska Institutionen, Stockholm.

WEEKLY DOSES FROM SOME NATURAL RADIOACTIVE SOURCES. B. Hultqvist. July 1956. 7p.

Data are given on weekly radiation doses received in Sweden from flat ground with varying radioactive content, in Swedish houses, from radon and atmospheric decay products, and from permanent background. (T.R.H.)

1617 NRL-5526

Naval Research Lab., Washington, D. C.

ATMOSPHERIC RADIOACTIVITY IN SOUTH AMERICA AND ANTARCTICA. L. B. Lockhart, Jr. June 16, 1960. 10p. Project RR 004-02-41-5151.

Information on the concentration of the major natural radioactive species and of gross fission product β activity in the ground-level air at several sites in South America and Antarctica is reported. Fission products were found to be a minor contributor to the radioactivity of the air in the Southern Hemisphere except that in the antarctic region (and presumably at some island sites) it assumes relatively more importance because of the low concentrations of natural activity there. Seasonal variations in one or more of the radioactive components of the atmosphere are evident at each of the various sites. (auth)

1618 TID-5971

Western Precipitation Corp., Los Angeles.

A CONCEPTUAL STUDY OF POSSIBLE COLLECTING SYSTEMS FOR USE IN STRATOSPHERIC SAMPLING. W. T. Sproull. Apr. 25, 1959. 91p. Contract AT(04-3)-234. OTS.

Methods based on electrical, mechanical, and thermal separation processes, under conditions of relatively long molecular mean-free-path in the suspending air, are considered for use in sampling particulate matter in the upper atmosphere. With reasonable restrictions of weight and time of collection, success may be expected using sufficiently refined designs based on each of these methods. Certain advantages and disadvantages are associated with each, as might be expected, but the greatest possibility of success appears to be offered by a centrifuge designed carefully to maintain laminar flow. (auth)

1619 TID-6485

Isotopes, Inc., Westwood, N. J.

STUDIES OF NUCLEAR DEBRIS IN PRECIPITATION. Quarterly Progress Report No. 4. July 15, 1960. 57p. Contract AT(30-1)-2415. OTS.

Modifications to the measuring methods discussed in previous reports are reviewed. These include the addition of extra pots to measure precipitation after each storm and measuring methods in which cylindrical polyethylene collectors, large type collectors, the 8-in. rain gage, and the universal weighing type rain gage are used. The U. S. Weather Bureau's 8-in. rain gage was chosen as a standard for collection efficiency, and graphs of volume of precipitation collected versus the inches precipitation as measured by this rain gage are included for each collector. A discussion of the correlation between Sr^{90} specific activity and amount of precipitation is included. It is noted that large differences in total world fall-out integrals obtained by the various methods are not expected; however, amendment of data from the southern hemisphere is not justified since these data are sparse, and considerable uncertainty is attached to the regression coefficient. Isotope ratio data from analyses of precipitation collected at Fayetteville, Ark., Pittsburg, Pa., and Richmond, Calif., are compared with results from Westwood, N. J. In an examination of tropopause behavior and Sr^{90} specific activities in rainwater, it is noted that a possible relationship exists between low warm tropopause conditions and high specific activities of Sr^{90} in rainfall. (For preceding period see TID-5710.) (J.R.D.)

1620 TID-6841

Columbia Univ., Palisades, N. Y. Lamont Geological Observatory. Geochemical Lab.

QUALITY OF Sr^{90} ANALYSES ON HUMAN BONE. Interim Technical Report. J. Laurence Kulp. May 1960. 29p. OTS.

A review is presented of the status of the analytical work on the Sr^{90} determinations in human bone that have been made in various laboratories over the past 7 years. The specific problems discussed include absolute calibration, radiochemical reproducibility, contamination, and reproducibility of very low-level samples. A comparison is

made between analytical and biological variations. It was concluded that absolute calibration of the analysis of human bone for Sr^{90} can be, and generally has been, done to within ±3%. An accuracy, with corrections, of ±5% can be assumed for sufficiently high levels. Reproducibility is about 13% for powdered milk and better for bone ash. Contamination has been absent or infrequent. Routine performance achieved a standard deviation of ±15% for bone carrying >2 dpm. One dpm may be considered a practical lower limit. The analytical accuracy (±15%) is small compared to apparent biological variations in the most homogeneous population groups (±30%). (T.R.H.)

1621 AEC-tr-3888

Germany. Bundesministerium für Wohnungsbau, Bonn. SPECIFICATIONS FOR BLASTPROOF SHELTERS. Translation of Richtlinien für Luftstossichere Schutzbauten. 1959. 55p. OTS.

Specifications are given for the construction of new shelters. The blastproof shelter is a structure enclosed on all sides by a framework that is rigid to bending in every direction. The shelter consists of a pressure chamber with enclosing structural parts. The pressure chamber includes the shelter room proper, supporting and nonsupporting inner walls, the entrance with its protective parts, door frames, gas locks, and the emergency exit with sand filter unit. It contains installations for ventilation, sanitation, and supply. (W.L.H.)

1622 AEC-tr-3891

Germany. Bundesministerium für Wohnungsbau, Bonn. PROVISIONAL SPECIFICATIONS FOR THE INSTALLATION OF ELECTRIC HIGH- AND LOW-CURRENT SYSTEMS IN RECONDITIONING WORK ON PROTECTIVE BUNKERS. Translation of Vorläufige Richtlinien für die Ausstattung mit Elektrischen Stark- und Schwachstromanlagen bei der Wiederinstandsetzung von Schutzbunkern. 1958. 44p. OTS.

Specifications are given for the installation of electric high- and low-current systems in reconditioned air-raid bunkers. They govern the design, construction, and performance of these installations as well as the structural layout influenced by them. (W.L.H.)

1623 AEC-tr-3892

Germany. Bundesministerium für Wohnungsbau, Bonn. PROVISIONAL SPECIFICATIONS FOR CONSOLIDATION WORK IN THE RECONDITIONING OF PROTECTIVE BUNKERS. Translation of: Vorläufige Richtlinien für den Ausbau bei der Wiederinstandsetzung von Schutzbunkern. 1958. 23p. OTS.

Specifications are given for the design, structure, and construction work needed to recondition existing protective bunkers. Existing bunkers are air-raid shelters remaining from the time of World War II and constructed according to the regulations in force at that time. They are surface or underground bunkers of steel-reinforced concrete or unreinforced concrete, with enclosing parts and structural parts of varying thickness and differing reinforcement. The reconditioned bunkers must offer protection against the effects of incendiary, atomic, biological, and chemical weapons. (W.L.H.)

1624 JPRS-5649(p.133-43)

THE CONTAMINATION OF RESERVOIR SURFACES WITH RADIOACTIVE SUBSTANCES. S. M. Drachev and A. A. Bylinkina. Translated from Med. Radiol. 6, No. 6, 54-8 (1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22748.

1625 JPRS-5649(p.144-60)

THE Sr^{90} CONTENT IN MILK IN CERTAIN AREAS OF CZECHOSLOVAKIA IN 1957–1959. J[aroslav] Nosek and V[ilem] Santholzer. Translated from Med. Radiol. 6, No. 6, 58-60(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 22749.

1626

A PRIMER ON PRACTICAL WAYS TO COLLECT BERYLLIUM DUST. PART I. A. J. Breslin and W. B. Harris (U. S. Atomic Energy Commission, New York). Air Eng. 2, No. 7, 34-6; 53(1960) July.

A description is given of the experience gained during 10 years of collecting beryllium dust. The methods described include discussions on hood design, enclosure techniques, local exhaust ventilation, and process ideas. Ventilation problems are discussed for such processes as machining, grinding, vacuum casting, sintering, fabrication, sublimation, chlorination, fusion, and reduction of the metal from a salt. (B.O.G.)

1627

A TRACER TECHNIQUE TO MEASURE DEPOSITION OF STACK EMISSIONS. E. J. Schulz, R. A. Duffee, R. I. Mitchell, and E. W. Ungar (Battelle Memorial Inst., Columbus, Ohio). Am. Ind. Hyg. Assoc. J. 21, 343-9(1960) Oct.

A tracer technique is described which is a useful tool in the quantitative measurement of the particulate deposition rate of industrial emission. The variable decompositions of uranine solutions exposed to the atmosphere in dust-fall containers prevent the use of dust-fall jars as sampling devices. Based on the laboratory study, uranine can be dispersed as a tracer into stack at stack-gas temperatures up to 600°F without decomposition. With direct stack injection, losses of tracer in the stack must be determined for each application. In using uranine it is mandatory that background fluorescence be determined in the area to be investigated. However, the technique is not limited to uranine. Any soluble material that satisfies the requirements of a tracer can be employed with this method. (auth)

1628

EFFICIENCIES OF FILTER PAPERS FOR COLLECTING RADON DAUGHTERS. Darrell E. Anderson (U. S. Public Health Service, Salt Lake City, Utah). Am. Ind. Hyg. Assoc. J. 21, 428-9(1960) Oct.

The efficiency of several filter papers for the collection of atmospheric particles of radon daughters was measured. Test atmospheres were drawn through papers in a sampling head directly attached to the inlet of an electrostatic precipitator tube. The total α activities and shapes of all the decay curves were determined for each filter. Data are tabulated. (C.H.)

1629

PUBLIC PROTECTION IN AN OPEN EXHIBIT OF RADIOACTIVITY. William B. Harris (Health and Safety Lab., U. S. Atomic Energy Commission, New York). Arch. Environmental Health 1, 377-91(1960) Nov.

The 1958 United Nations atomic energy exhibits and especially the safety precautions employed are described and discussed. There was thorough advanced planning and daily inspections by experienced personnel. Recommendations based on this experience are given relating to advanced planning, ventilation, waste disposal, emergency evacuation, fire extinguishers, alarm system, briefing on routine and emergency procedures, inspections, competence of safety personnel, contact with local authorities, and insurance carriers. (T.R.H.)

1630

THE INDUSTRIAL HYGIENE OF URANIUM REFINING. Emil Christofano and William B. Harris (Health and Safety Lab., U. S. Atomic Energy Commission, New York). Arch. Environmental Health 1, 438-60(1960) Nov.

Uranium refining operations and equipment are described, and a study of occupational exposure to uranium-bearing dust is reported. The total of refinery personnel rose from 400 in 1948 to 500 in 1954 and 3000 in 1960. Data on exposure to α-emitting dust are cited and arranged to show that in 1948 almost all the workers were exposed to greater than present permissible air-dust levels. By 1955 only two operations led to excessive exposures. In 1948 and 1949 exposures were 400 times the present acceptable levels; by 1955 this amount was reduced to 4 times the admittedly conservative permissible level of 110 d/min/cu. m. (T.R.H.)

1631

MEASUREMENTS OF THE POTASSIUM AND CESIUM-137 CONCENTRATION IN THE GERMAN POPULATION. C. O. Onstead, E. Oberhausen, and F. V. Keary (U. S. Army Medical Research Unit, Europe). Atompraxis 6, 337-41 (1960) Sept. (In German)

The amount of potassium and Cs^{137} in 1000 persons living in Germany was measured with a human counter set up in Landstuhl (Palatinate). The results show that the potassium content is dependent upon sex and age. Cesium measurements are given in $\mu\mu c$ of Cs^{137}/g of potassium and in $\mu\mu c$ of Cs^{137}/kg of body weight. The measurements are also compared with earlier data collected in the U.S.A. The average dose imposed by cesium in the human body at present is 1.8 mrem/year. (auth)

1632

CALCULATION OF RADIATION PROTECTION ON THE BASIS OF PRESENT REGULATIONS. Rolf Plesch (Siemens und Halske AG., Karlsruhe, Ger.). Atompraxis 6, 348-52 (1960) Sept. (In German)

The diagrams given in earlier studies (Atompraxis 4, 11 (1958) and Atompraxis 5, 2(1959)) for calculating protection against γ radiation in accordance with the Euratom Regulations and the International Agreement on Railway Freight Traffic are dealt with; their application is illustrated with practical examples. For cases in which the diagrams cannot be applied directly, a method of gradual approximation is given; this method produces quick results owing to its good convergence. (auth)

1633

MEASUREMENT OF ABSORBED DOSE IN AN INHOMOGENEOUS FIELD OF RADIATION WITH AN EXTRAPOLATION CHAMBER WITH DIAPHRAGM. G. B. Radziyevskii (Inst. of Biological Physics, Academy of Sciences, Moscow). Biophysics (U.S.S.R.) (English Translation) 5, 238-49(1960).

The method described of a wide flat ionization chamber with variable clearance between electrodes and the diaphragm can be applied to measure the strength of the absorbed dose in air in an inhomogeneous field of soft x radiation close to the source. The method makes it possible to achieve with ease saturation conditions in the chamber with dose intensities of the order of 10^6 r/min, and higher, for a clearance width in the chamber of 1 cm. Criteria for operation are included. (C.H.)

1634

CERTAIN ASPECTS OF THE DOSIMETRY OF DISTRIBUTED SOURCES OF β-RADIATION. A. M. Kononenko and V. A. Petrov (Central Medical Radiology Research Inst., Ministry of Health, Leningrad). Biophysics (U.S.S.R.) (English Translation) 5, 250-9(1960).

The distribution of dose rate at a flat interface from β emitters distributed in semi-infinite media and in a flat layer of finite thickness was calculated. The calculations were made by summating the dose rate from the monoenergetic components, the totality of which approximately makes up the β spectrum. The distribution of dose rate was obtained graphically for the entire important interval of the depth of the penetration of electrons. It has been determined that the distribution of dose rate of β emission for semi-infinite medium and flat layers over a considerable interval of depths is of an exponential nature. Simple formulas were accordingly derived for calculating the distribution of dose rate of β emission in the conditions considered. (auth)

1635

DATA ON THE EFFECT OF URANIUM AND OF ITS COMPOUNDS ON HUMAN BODY. O. S. Andreeva. Gigiena i Sanit. 25, 77-82(1960) May. (In Russian)

A review is presented of published data on the toxic effects of uranium and uranium compounds on personnel in industry and laboratories. (R.V.J.)

1636

RADIATION WARNING SIGNS FOR MEDICAL INSTALLATIONS. M. Brucer and R. J. Cloutier (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Intern. J. Appl. Radiation and Isotopes 8, 143-5(1960) July. (In English)

A series of radiation warning signs are described which were designed to inform personnel of real or potential hazards from radioactive materials in medical installations. (C.H.)

1637

STRONTIUM-90 IN SURFACE WATER IN THE UNITED STATES. Conrad P. Straub, Lloyd R. Setter, A. S. Goldin, and Paul F. Hallbach (Robert A. Taft Engineering Center, Cincinnati). J. Am. Water Works Assoc. 52, 756-68(1960) June.

A determination was made of Sr^{90} activity levels for the major surface waters of the U. S. From these values, it was calculated that the average runoff of Sr^{90} amounts to 4 curies/day, corresponding to 0.5 mc/sq mile/year, or 190 $\mu\mu c$/sq mile/year. The total gross fall-out contribution was calculated as 23,900 curies/day, of which 408 curies/day is found in runoff. The current maximum permissible concentration level of Sr^{90} in drinking water for an uncontrolled area is 100 $\mu\mu c$/l, one-third of which was suggested as the average concentration applicable to the entire population. Food, not water, is the major source of Sr^{90} intake; water may be responsible for ~10% of the ingested Sr^{90}. In places where cisterns are used for water supply, the Sr^{90} from water is ~35 to 50% of the total intake. (B.O.G.)

1638

NATURAL RADIOACTIVITY IN ILLINOIS WATER RESOURCES. Thurston E. Larson and Richard L. Weatherford (State Water Survey Div., Urbana, Ill.). J. Am. Water Works Assoc. 52, 769-78(1960) June.

All measurements made since May 1957 were of samples of well waters, streams, and rivers and were limited to gross α and β activities by proportional counting of the nonvolatile residue remaining after evaporation of the water carrier. Such residues do not contain H^3; therefore it is not discussed. Libby showed that the β activity of H^3 in the Mississippi River was 5 to 20 $\mu\mu c$/l; Lake Michigan, 5$\mu\mu c$/l; and in the rainfall in the Midwest, ~20 $\mu\mu c$/l. The physiological significance of gross activity and specific radioactive isotopes and the optimum and standard procedures for the determination of gross and specific

activities are not discussed. Considerations are given to the radioactivity of ground waters; excerpts from the Lucas and Ilcewicz interpretations of data on Ra^{226}; and data on gross activity of surface waters. (B.O.G.)

1639

ESTIMATING HUMAN RADIATION EXPOSURE ON THE ANIMAS RIVER. Ernest C. Tsivoglou, S. David Shearer, Jr., John D. Jones, and Don A. Clark (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Am. Water Works Assoc. 52, 1271-90(1960) Oct.

Recent comprehensive studies of radioactive pollution of the Animas River by refinery wastes of uranium ore indicated that the total internal radiation exposure of downstream populations was greater than the limits recommended for general population exposure. Studies of the fate of Ra^{226}, the primary pollutant, in the stream environment and in local water plants led to the development of rational efficient pollution-abatement measures. These measures were installed quickly, and subsequent surveys showed that they resulted in a much higher standard of radiation protection than would have been achieved by enforcement of preset arbitrary effluent or stream standards. During the months following the release of the reports of the studies, some local public apprehension developed. This apprehension could have been minimized by a more aggressive public information program. (auth)

1640

ENVIRONMENTAL RADIOACTIVITY PRIOR TO NUCLEAR POWER PLANT OPERATION. John V. Nehemias, G. Hoyt Whipple, and Navnit C. Kothary (Univ. of Michigan, Ann Arbor). J. Am. Water Works Assoc. 52, 1291-1302 (1960) Oct.

When any major nuclear production facility is planned, the possibility that radioactive materials may be inadvertently released into the environment must be considered. Evaluation of the impact of plant operation on the levels of radioactivity in the environment implies knowledge of radioactivity levels present before operation begins. A preoperational survey of environmental radioactivity has been in progress for 2 years in the vicinity of the power reactor being constructed in Southeastern Michigan by the Power Reactor Development Co. Environmental radioactivity has demonstrated a general increase throughout 1958, continuing into the spring of 1959, and a general decrease thereafter throughout 1959. (auth)

1641

INNOVATIONS IN WATER CLARIFICATION. Walter R. Conley and Raymond W. Pitman (General Electric Co., Richland, Wash.). J. Am. Water Works Assoc. 52, 1319-25 (1960) Oct.

A 5-gpm experimental filter plant has been in operation for approximately 4 years. Useful data on chemical treatment and filter materials were obtained. The principle achievements from the use of the plant are improved water filters, improved chemical treatment methods, and a demonstration of practical filtration with a flocculation time as short as 10 min, a settling time as short as 60 min, and a filtration rate as high as 10 gpm/sq ft. An improved chemical treatment method was developed which uses 5 to 50 ppb of organic polyelectrolytes to control filter breakthrough. This treatment used in conjunction with filters made of both 0.4 mm sand and 0.9 to 1.5 mm anthracite, makes it possible to filter water at very high rates without excessive head loss. The resulting filtered water is exceptionally clear, with <0.01 ppm turbidity. Results obtained in the experimental filter plant have been confirmed in large-scale filtration plants. (auth)

1642

ON METHODS OF CONTROL OF THE PROTECTION IN ROENTGEN DEPARTMENTS OF MEDICAL INSTITUTIONS. R. V. Stavitskiĭ (Central Inst. of Graduate Work in Medicine, Ministry of Health, USSR). Med. Radiol. 5, No. 8, 52-3(1960) Aug. (In Russian)

Methods and rules are suggested for personnel protection in hospitals and clinics employing diagnostic and therapeutic x radiation. Permissible doses are discussed. (R.V.J.)

1643

SEMIAUTOMATIC LINE PRODUCTION FOR WORK WITH AMPULLATED RADIOACTIVE SOURCES IN GYNECOLOGY. A. Ya. Berlovskiĭ. Med. Radiol. 5, No. 8, 54-62(1960) Aug. (In Russian)

An improved semiautomatic line production is recommended for work with ampullated radioactive sources in gynecology. (auth)

1644

THE ENGINEERING ASPECTS OF THE WATER VAPOR PERMEABILITY OF GLOVE MATERIALS. J. E. Ayer, R. M. Mayfield, and D. R. Schmitt (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 8, 274-6(1960) Sept.

Gloveboxes are frequently used for the protection of personnel and containment of an inert atmosphere within which operations upon pyrophoric or physiologically hazardous materials are performed. Leakage or diffusion of water vapor through gross leaks or through gloves may necessitate purification of the inert atmosphere. Since the required capacity of the purification system involves a summation of in-leakage from all sources, quantitative information on the role of the glove as a contributing factor is of importance. The engineering application of an investigation into the role of the permeability of glove materials is indicated. Water vapor permeability through various glove materials was determined mathematically as a function of film thickness, partial pressure of water vapor differential across the film, film surface area, and the permeability constants for a particular "compound." Calculations indicate that a sample glove exposed to air at 75°F and 50% relative humidity on one surface and to a very low humidity on the other side will contribute 0.22 g of water vapor per day to a glovebox system. The same glove in use by an operator will contribute up to 2.8 g of water per day due to the increased partial pressure of water vapor differential between the two glove surfaces. These calculations allow the quantitative determination of water permeation through gloves and its effect upon the desired purity or operating dew point of a protective atmosphere system and its purification equipment. (auth)

1645

RADIOACTIVE PARTICLES IN THE FISSION PRODUCT ACTIVITY OF THE ATMOSPHERE. Wolfhard Kern (Universität, Bonn). Nukleonik 2, 203-13(1960) Sept. (In German)

A survey of the fission-product particles found in the atmosphere in the last few years is given. The "hot" particles with an activity of 10^{-10} c/particle are of special interest. The origin, composition, size, and activity of hot particles are described. In addition, detection methods, statistical regularity, γ spectra, and other properties of hot particles are considered. The meteorological and biological problems occurring in the dispersion and incorporation of radioactive particles are discussed briefly. (tr-auth)

1646

THE STRONTIUM-90 LEVEL IN MILK AND BONES OF

CATTLE AND HUMAN BEINGS IN POLAND IN 1958. Julian Liniecki, Wanda Czosnowska, and Zofia Pietrzak (Inst. of Medicine, Lodz, Poland). Nukleonika 5, 301-13 (1960). (In Polish)

Results are given for Sr^{90} determinations in samples of powdered milk and cattle bones from various regions of the country. Data are included on the Sr^{90} content of vertebrae, derived from human-beings who died in Łódź at 20 years of age or more. All samples were collected during the second half of the year 1958. Determinations were performed by the slightly modified method of Volchok et al. The average Sr^{90} content was 9.4 $\mu\mu c$/g calcium for cattle bones; 6.5 $\mu\mu c$/g calcium for powdered milk; and 0.9 $\mu\mu c$/g calcium for corpora of human vertebrae. These results were compared with results from other countries. Emphasis was placed on the relatively high Sr^{90} content of the corpora of human vertebrae in relation to the average activity for whole human skeletons as reported elsewhere. Data for milk and animal bones are in good agreement with foreign results. (auth)

1647

THE DEPENDENCE OF RBE ON THE ENERGY OF FAST NEUTRONS. I. PHYSICAL DESIGN AND MEASUREMENT OF ABSORBED DOSE. H. H. Rossi, J. L. Bateman, V. P. Bond, L. J. Goodman, and E. E. Stickley (Brookhaven National Lab., Upton, N. Y.). Radiation Research 13, 503-20(1960) Oct.

An experimental design to clarify the relative biological effectiveness of fast neutrons with respect to x or γ radiation is given. A proton beam from a Van de Graaff accelerator and a tritiated zirconium target provide the neutrons. Tissue equivalent chambers and their arrangement in the exposure cage were developed. Dosimetry was monitored by a 25-r Victoreen chamber. The biological effects chosen were spleen and thymus atrophy. (T.R.H.)

1648

MEGAROENTGEN DOSIMETRY EMPLOYING PHOTOGRAPHIC FILM WITHOUT PROCESSING. William L. McLaughlin (National Bureau of Standards, Washington, D. C.). Radiation Research 13, 594-609(1960) Oct.

The new photographic method of high-level dosimetry of x and γ radiation involves two steps. Large radiation exposures are given, resulting in the formation of print-out image in the silver halide emulsion layers of ordinary commercial x-ray films, without requiring photographic processing for the evaluation. The unknown exposure is measured by means of a special densitometric procedure, the exposure being related to the net density of the print-out darkening on a characteristic curve obtained with known exposures. The density readings are made with a narrow band of red light, obtained by placing a suitable band-pass filter between the densitometer light source and the film. Gamma-radiation exposures from 2×10^4 to 10^8 r can be read with a precision limit of ±5%, under appropriate conditions of densitometry. The response is rate-independent, and the print-out image is stable. The chief limitations in the method are a considerable dependence of response on radiation energy below 0.3 Mev and the requirement of controlling the temperature during exposure to within ±10°C for accurate readings. (auth)

1649

RADIOLOGICAL DECONTAMINATION. THEORETICAL AND PRACTICAL ASPECTS. D. G. Stevenson (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Research (London) 13, 383-9(1960) Oct.

The factors involved in the adsorption of radioisotopes on nonmetallic surfaces include ion exchange, physical adsorption, and direct penetration; although in many cases 'surface films' act as barriers. On metallic surfaces contaminants appear to be bound by adsorption on oxide films or by exchange with the metal itself. The method of removal must be related to the mechanism by which the contaminant is held, but may be broadly classified as detergency, ion displacement, and surface removal. (auth)

1650

RADIATION PROTECTION. RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. ICRP PUBLICATION 2. REPORT OF COMMITTEE II ON PERMISSIBLE DOSE FOR INTERNAL RADIATION (1959). Published for The International Commission on Radiological Protection. New York, Pergamon Press, 1959. 262p.

The committee report begins with a description of the organization of the ICRP including personnel and policies, followed by a review and statement of basic concepts. Major changes in basic recommendations are discussed along with comparison to the previous report and guiding principles for application of the report. The recommendations are grouped under the titles: Basic Standards of Maximum Permissible Internal Exposure, Maximum Permissible Values for Occupational Exposure, Calculation of Maximum Permissible Exposure values, and Factors Needed for Calculation of MPC Equations. Extensive tabulations of physical constants and useful data are included. (T.R.H.)

1651

SPECTROSCOPY OF RADIOACTIVE MATERIALS. John G. Conway (Univ. of California, Berkeley). p.26-33 of "Symposium on Spectroscopy. Special Technical Publication No. 269." Philadelphia, American Society for Testing Materials, 1959.

The principal point in approaching the handling of radioactive materials is to concentrate and confine the material in as small a volume as possible and then to filter the air before discharging into the atmosphere. A gloved box used for handling radioactive materials for study by spectroscopic methods is described. Experiments with the filter train of the box showed that when a sample of 10^{10} counts per minute was sparked, some 75% was caught on the first filter. About 5 to 7% settled on the walls of the chamber and the tubing to the filter. A monitor filter located after the second filter and before the pump had no detectable activity. Examples are given of how experiments may be performed with radioactive substances. (M.C.G.)

1652

Public Health Service, Washington, D. C.
RADIOLOGICAL HEALTH DATA MONTHLY REPORT, AUGUST 1960. Volume 1, No. 5. 53p. $0.50(OTS).

The Public Health Service Milk Monitoring Program is described, and data on radioactivity in milk are given. Monitoring of the air is described, and data of the USNRL, ANL, and PHS are given. Water monitoring by the PHS and HASL is described, and data are also given. Other data given include external, γ activity, radioisotopes in medicine, soil sampling, food consumption in the U. S., state radiological health activities, and the contribution of short-lived radioisotopes. (T.R.H.)

1653

International Atomic Energy Agency, Vienna.
SAFE HANDLING OF RADIOISOTOPES, HEALTH PHYSICS ADDENDUM. G. J. Appleton and P. N. Krishnamoorthy. Safety Series No. 2. 1960. 120p. $1.50.

Problems encountered by the small user of radioisotopes

are treated. Basic health-physics principles are outlined, and fundamentals such as nuclear physics, radiation effects, radiation units, and maximum permissible doses are discussed. Other topics covered are measurement of radiation, instruments, radiation control, shielding, design of working places, handling equipment for radiation sources, containers for radioactive materials, protective clothing, transport of radioactive materials, decontamination, disposal of radioactive wastes, emergency procedures, and administration of radiation protection. An annex of useful health-physics data is given along with other tables, diagrams, and illustrations. (T.R.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

1654 AD-235363

American Can Co., Barrington, Ill.

RESEARCH STUDY ON CAN ENAMELS AS PART OF THE RADIATION PRESERVATION OF FOODS PROGRAM. Report No. 8 (Progress) [for] January 29, 1959–April 28, 1959. G. B. Pratt. 13p. Project No. 7-84-01-002. Contract DA-19-129-QM-968.

One or more can enamels have performed satisfactorily for each product to date. Beef, codfish, and pork canned with active enzymes have produced gas on storage. (auth)

1655 AD-235512

Oregon State Coll., Corvallis and Oregon. Agricultural Experiment Station, Corvallis.

STUDY AND INVESTIGATION OF RADIATION RESISTANT ORGANISMS IN FOODS. Report No. 10 (Progress) [for] Period September 1, 1959–November 30, 1959. A. W. Anderson. 11p. Project No. 7-84-01-002. Contract DA-19-129-QM-1055.

The tests using various additives indicate that 3% salts at the 2- and 3-megarad levels were effective for the destruction of Cl. botulinum strain A-5 and strain B-115. Of the spices only mustard (allyl isothiocyanate) enhanced the lethal effect of irradiation at the 1.5-, 2-, and 3-megarad levels for strain A-5 and 2 and 3 megarad for strain B-115. No organisms were recovered from inoculated packs of ground round containing 3% salt and exposed to 2 and 3 megarad of γ irradiation. No organisms were recovered from inoculated packs of ground round containing mustard (allyl isothiocyanate) when subjected to 2 or 3 megarad of γ irradiation. (auth)

1656 AD-235514

Stanford Research Inst., Menlo Park, Calif.

RADIOACTIVITIES PRODUCED IN FOODS BY HIGH-ENERGY ELECTRONS. Summary Technical Progress Report for Period January 15, 1958–December 14, 1959. Report No. 10. Richard A. Glass and Herbert D. Smith. Jan. 14, 1960. 129p. Contract DA19-129-qm-1100.

Research on radioactivity induced in food by radiosterilization with high-energy electrons is summarized. Measurements were made on individual food elements and on foods themselves and compared with computations based on empirical equations and with calculations of radioactivities by theoretical analysis. The results show that a small amount is added to natural radiation levels, the most important isotopes being Na^{22}, P^{32}, P^{33}, S^{35}, Mn^{54}, Fe^{55}, Zn^{65}, Rb^{84}, and I^{126}. The radioactivity produced is close to or lower than the minimum level detectable. The dose received from ingested irradiated food is below that from natural external sources. The effect of food-element abundance was given special consideration. Radioactivities produced in plastic, aluminum, and tinplate containers were also determined. These were smaller than in the food, but may add a small amount to the radiation level around irradiated food packages. (T.R.H.)

1657 AD-235527

American Meat Inst. Foundation, Chicago.

A STUDY OF CHEMICAL CHANGES PRODUCED BY HEAT AND BY IRRADIATION OF MEAT AND MEAT FRACTIONS. Report No. 4 (Progress) [for] June 24, 1959–September 23, 1959. W. A. Landmann. 5p. Project No. 7-84-01-002. Contract DA-19-129-QM-1293.

The phospholipid fraction of irradiated whole ground round of beef was separated with a silicic acid column. One fraction containing a strong "wet dog hair" odor was obtained. Chemical tests to characterize this fraction are described. (auth)

1658 AD-235528

California. Univ., Davis.

STUDIES ON PHYSICAL AND CHEMICAL MODIFICATION OF PROTEINS FOR THE PREVENTION OF IRRADIATION OFF-FLAVORS IN MEAT. Report No. 4 (Progress) [for] May 15, 1959–August 14, 1959. A. L. Tappel. 5p. Project No. 7-84-01-002. Contract DA-19-129-QM-1172.

Progress is reported on resolubilization, paper electrophoresis, alkylation, and chromatographic separation of irradiation-precipitated proteins; some breakdown products of irradiated glutathione, and infrared studies on irradiated vitamin E. (auth)

1659 AD-235529

Continental Can Co., Inc., Chicago.

DETERMINATION OF THE SUITABILITY OF ALUMINUM CONTAINERS FOR THE PACKAGING OF IRRADIATED FOODS. Report No. 1 (Progress) for March 1, 1959–May 28, 1959. A. G. Skibbe. 6p. Project No. 7-84-01-002. Contract DA-19-129-QM-1327.

Green beans in brine, dry whole-kernel corn, and peaches in syrup were irradiated in rectangular drawn aluminum cans at 5×10^6 rads. No results are reported. (T.R.H.)

1660 AD-235589

Oregon State Coll., Corvallis and Oregon. Agricultural Experiment Station, Corvallis.

DEVELOPMENT OF IRRADIATION STERILIZED SHELF-STABLE FISH AND SEAFOOD PRODUCTS. Report No. 2 (Progress) for April 12, 1959–July 11, 1959. H. W. Schultz. 4p. Project No. 7-84-01-002. Contract DA-19-129-QM-1356.

Frozen precooked breaded sea foods were irradiated at 1.5, 3.0, and 4.5 megarad. Of the many products screened, fish sticks (cod), fish cakes (cod), shrimp, and oysters seemed to be acceptable after irradiation. A nonenzymatic browning reaction initiated by irradiation renders many of the products dark in color and undesirable in appearance after storage at 70 and 100°F. Radiation of Vream, a hydrogenated shortening, alone and with the antioxidants BHA, BHT, quercetin, propyl gallate, and NDGA at 0.02 and 0.05% yielded no increase in TBA number, peroxide value, or total carbonyls after storage at 3 and 6 weeks at 100°F. (auth)

1661 AD-235592

National Dairy Products Corp. Research and Development Div., Glenview, Ill.

EFFECTS OF RADIATION ON FRESH FRUIT AND VEGETABLE AND DAIRY PRODUCTS. Report No. 1 (Progress) [for] December 9, 1958–July 31, 1959. W. L. Hock. 5p. Project No. 7-84-01-002. Contract QM R&E (Natick) No. 112.

Dried whey was irradiated in doses from 0 to 3.0×10^6

rad. Even at 0.5×10^6 rad, the microorganism population was drastically reduced. No detrimental flavors were noted in white sauce prepared from any of the irradiated samples. Strawberry preserves in covered glass jars were surface irradiated in doses up to 10^6 rad. A decrease in mold count was evident. Bleaching and flavor loss occurred at the surface, but no irradiation odor was produced up to the maximum dosage. (auth)

1662 AD-235593
Michigan. Univ., Ann Arbor. Research Inst.
DETERMINATION OF RADIATION STERILIZATION DOSE FOR CANNED MEAT. Report No. 11 (Progress) [for] May 1, 1959–July 31, 1959. L. L. Kempe. 9p. Project No. 7-84-01-002. Contract DA-19-129-qm-964.

A small but significant effect of temperature during irradiation on the lethality of γ rays for Clostridium botulinum spores was shown. Protection occurred at 40 to 80°C. The magnitude of the effect is about 10%. Likewise, a small effect of radiation intensity also appears to exist. Gamma rays were found to be about 10% less efficient at a field intensity of 0.500 than at 0.002 megarad per hour. This latter finding must still be considered tentative, however. (auth)

1663 AD-235594
Michigan State Univ., East Lansing.
DIP COAT PACKAGING OF IRRADIATED FOODS. Report No. 7 (Progress) [for] Period May 15 1959–July 14, 1959. L. J. Bratzler. 5p. Project No. O.I.6169. Contract DA 19-129-QM-1195.

Progress is reported on three and six months 0°F storage of roast chicken and roast pork coated with three plastic materials. No appreciable change in TBA values, taste panel scores, and weight has taken place owing to storage. One wax formulation was discarded because of severe blocking. (auth)

1664 AD-235597
Southern Research Inst., Birmingham, Ala.
DETERMINING THE FUNCTIONAL PROPERTIES OF FOOD CONTAINERS USED FOR FOODS IRRADIATED IN COMBINATION WITH MODEL FOOD SYSTEMS. Report No. 18 (Progress) [for] Period May 25, 1959–July 24, 1959. Bobby C. Moses and Robert E. Burks, Jr. 7p. Project No. 7-84-01-002. Contract DA-19-129-QM-759.

A study was made of factors that affect stress-cracking and the production of extractives in plastic packaging materials for foods preserved by irradiation. Polystyrenes were observed for stress-cracking in Igepal CO-630 and lactic acid solutions and in slurries of sausage and cheese. Polypropylene was studied in milk and slurries of apples. The odors of several polyethylenes irradiated in water were compared, but no correlation was found between odor and any of the known properties of the samples studied. The amount of organic matter extracted by water from irradiated polyethylenes was determined analytically. Although the data showed an apparent trend in that high-density polyethylenes produced less extractives, the correlation was statistically of rather low significance. It was not possible to correlate odor or amount of extractives with any properties of the films. (auth)

1665 AD-235599
New York. State Agricultural Experiment Station, Geneva.
A STUDY OF THE RADIATION-INDUCED SOFTENING OF PLANT TISSUES. Report No. 6 (Progress) [for] April 1, 1959–June 30, 1959. Z. I. Kertesz. 5p. Project No. 7-84-01-002. Contract DA-19-129-QM-1164.

Respirational stimulation in lettuce brought about by gamma irradiation does not appear to be a reasonable explanation for the observed softening. Respirational measurements of irradiated apple tissues indicate that this is true. (auth)

1666 AD-235600
New York. State Agricultural Experiment Station, Geneva.
A STUDY OF THE RADIATION-INDUCED SOFTENING OF PLANT TISSUES. Report No. 7 (Progress) [for] Period July 1, 1959–September 30, 1959. Z. I. Kertesz. 10p. Project No. 7-84-01-002. Contract DA-19-129-QM-1164.

Studies of the effect of γ irradiation on four varieties of sweet cherries indicate an average radiation-induced softening threshold dosage of about 53×10^3 rad and about a 30% softening at the recommended 232×10^3 rad "pasteurization dosage." No detrimental flavor or color changes and only slight and transient respiratory abnormalities were found. (auth)

1667 AD-235602
Department of Agriculture. Plant Disease Lab., Chicago.
CONTROL OF POST HARVEST DISEASES OF FRUITS AND VEGETABLES BY RADIATION TREATMENTS. Report No. 7 (Progress) [for] April 1, 1959–May 31, 1959. Louis Beraha and M. A. Smith. 8p. Project No. 7-84-01-002.

At 75°F there was no eradication or arrestment of all fungi within fresh Michigan blueberries at any of the doses tested between 0.5 to 5×10^5 rads. After 28 days storage, all berries showed fungal growth in nearly equal amounts to the non-irradiated controls regardless of the dose applied. When stored at 75°F injury to the berries in the form of softening and production of abnormal red color in the flesh occurred at 5×10^5 and 3×10^5 rads after 16 days and only slightly at 2.5×10^5 rads after 28 days. In vitro inactivation of some blueberry decay pathogens was well below 5×10^5 rads. (auth)

1668 AD-235604
Nestlé Co., Inc., White Plains, N. Y.
RADIATION STERILIZATION OF COCOA POWDERS. Report No. 2 (Progress) for May 17, 1959–August 17, 1959. C. McComb. 4p. Project 7-84-01-002. Contract QMR & E (NATICK) No. 114.

A study was made of the effects of 0.1, 0.3, and 0.6 megarad of γ radiation on microflora, flavor, and vitamin content of chocolate syrup. A dose of 0.3 was found to be the minimum useful dose bacteriologically. Vitamin content was not reduced, and no off-flavor was reported. (T.R.H.)

1669 AD-235605
Kentucky. Univ., Lexington.
THE EXTENSION OF STORAGE LIFE OF FRESH FRUITS AND VEGETABLES BY IONIZING RADIATION. Report No. 5 (Progress) [for] Period April 17, 1959–July 26, 1959. D. C. Martin. 5p. Project No. 7-84-01-002. Contract QMR&E (NATICK) No. 87 (Agreement).

The irradiation of strawberries to 10^6 and 2.5×10^6 rads and storage at 45°F are described. At 16 days the berries had lost color and were softer and less acceptable compared to blanched and unblanched controls. (T.R.H.)

1670 AD-235607
Stanford Research Inst., Menlo Park, Calif.
RADIOACTIVITIES PRODUCED IN FOODS BY HIGH ENERGY ELECTRONS. Report No. 9 (Progress) [for] Period June 15, 1959 to September 14, 1959. Richard A. Glass and Herbert D. Smith. 21p. Project No. 7-84-01-002. Contract DA-19-129-QM-1100.

The radioactivity in 6-lb cans of ground beef irradiated by 24-Mev electrons was measured using large NaI crystal counters. Activity from natural K^{40} and fall-out Cs^{137}

was also measured. The values found ranged from 1.0×10^{-7} to 1.3×10^{-7} μc/gram beef/5 megarads. A 0.88-Mev γ was observed which was thought to be from Rb^{84}. (T.R.H.)

1671 MND-P-2399

Martin Co. Nuclear Div., Baltimore.

SUMMARY REPORT OF THERMIONIC ISOTOPIC POWER SYSTEM THROUGH JUNE 30, 1960. Robert J. Harvey. 535p. Contract AT(30-3)-217. OTS.

The objective of the work to develop a thermionic generator was to establish feasibility by fabricating and testing a low-power isotopic-fueled thermionic power system. The research phase, which consisted of work from the most basic and fundamental principles up through and including the testing of a two-stage generator with design features considered practical for an isotopically fueled power system, is reported. (W.D.M.)

1672 NP-8977

Ekco-Alco Containers, Inc., Wheeling, Ill.

DEVELOPMENT OF CONTAINERS FOR IRRADIATED FOODS. Report No. 2 (Final) [for] January 21, 1957–January 20, 1959. R. O'Brien. 5p. Project No. 7-64-01-002. Contract QMR & D (Natick) No. 66 (Agreement).

An evaluation was made of the formability, heat sealability, and corrosion resistance of polyester film stretch-laminated to aluminum foil by heat and pressure. Clouding and crazing occurred during forming into smooth-wall containers. The containers sealed well, but the covers did not peel off satisfactorily. Corrosion was very high, probably owing to pin holing. Improved stretch-lamination would overcome most of these faults. (T.R.H.)

1673 NYO-9037

Isotopes, Inc., Westwood, N. J.

THE STUDY OF THE POTENTIAL APPLICATIONS OF RADIOISOTOPE TECHNOLOGY TO WATER RESOURCE INVESTIGATIONS AND UTILIZATION. Quarterly Report No. 1. June 1, 1960. 62p. Contract AT(30-1)-2477. OTS.

Major emphasis was placed on carrying out a general evaluation of the advances that were made in applying radionuclear techniques to the tracing of water. A survey was made of reports dealing with the use of radioactive tracers in tracing ground water, surface water, and industrial water. A preliminary summary of the work is included. A feasibility study was made of the use of stable nuclides as tracers with detection of the tracers in samples to be accomplished by neutron activation of the samples and radiochemical analysis of the resulting radioactive nuclides. A report of this study is presented. (W.L.H.)

1674 NYO-9038

Isotopes, Inc., Westwood, N. J.

THE STUDY OF THE POTENTIAL APPLICATIONS OF RADIOISOTOPE TECHNOLOGY TO WATER RESOURCE INVESTIGATIONS AND UTILIZATION. Quarterly Report No. 2. Sept. 15, 1960. 59p. Contract AT(30-1)-2477. OTS.

Progress in tracing surface and subsurface water using radioisotopes is briefly reported, and proposed experimentation is outlined. In the appendixes a literature review on radiotracers in studying sediment movement is presented along with an evaluation of tritium for water resources studies and proposals for study of the feasibility of using stable elements as water tracers and the feasibility of using radioisotopes in tracing soil moisture. (T.R.H.)

1675 RISÖ-16

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

PAPERS PRESENTED AT THE FIRST NORDIC MEETING ON FOOD PRESERVATION BY IONIZING RADIATIONS HELD AT RISÖ, APRIL 25-26, 1960. July 1960. 95p.

Separate abstracts were prepared on the 35 papers presented at the First Nordic Meeting on Food Preservation by Ionizing Radiation held at Risö, Denmark, April 1960. (C.H.)

1676 RISÖ-16(p.1-2)

EKONO, Helsinki.

FINNISH IRRADIATION SOURCES. E[ric] Rotkirch.

The planned new building for the Department of Biochemistry of the University of Helsinki will contain an irradiation facility that will be equipped with one 10,000 c Co^{60} unit and a neutron generator. These units are planned for operation by 1962. A 600 c Co^{60} source will be operated at the Biochemical Institute. The planned facilities are briefly described. (C.H.)

1677 RISÖ-16(p.3)

Svenska Institutet för Konserveringsforskning, Göteborg.

IRRADIATION EQUIPMENT AT THE SWEDISH INSTITUTE FOR FOOD PRESERVATION RESEARCH, GÖTEBORG. Jaan Teär.

A Co^{60} γ source was chosen as a radiation source for research in food preservation. The source is also available for industry, universities, and other interested research workers. A large cylindrical irradiation chamber with a total volume of 3.7 liters is provided. (C.H.)

1678 RISÖ-16(p.5-6)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

THE Co-60 IRRADIATION FACILITY AT THE DANISH RESEARCH ESTABLISHMENT, RISÖ. Ari Brynjólfsson.

The construction of the Co^{60} irradiation facility at Risö was finished in April 1960. The facility has been used for irradiation of potatoes, various kinds of vegetables, grains, meat products, dairy products, fish products, fruits, and for the sterilization of various pharmaceuticals and medical products such as plastic lungs. The facility is described and the source geometry is discussed. (C.H.)

1679 RISÖ-16(p.7-8)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

LINEAR ACCELERATOR IRRADIATION FACILITY AT RISÖ. Ari Brynjólfsson.

The electron accelerator irradiation facility at Risö is described. The accelerator is so designed that it can be used for many different kinds of research work. (C.H.)

1680 RISO-16(p.9-10)

Aktiebolaget Atomenergi, Studsvik, Sweden and Uppsala Univ. Gustaf Werner Inst. for Nuclear Chemistry.

ON THE ARRANGEMENT OF FREELY RADIATING GAMMA RAY SOURCES. Per-Olof Kinell and Börje Larsson.

The design, geometry, and application of a freely radiating Co^{60} γ source are described. (C.H.)

1681 RISÖ-16(p.11-12)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

RADIATION SOURCES IN THE STOCKHOLM AREA AVAILABLE FOR RADIOBIOLOGIC WORK. Lars Ehrenberg.

Two Co^{60} γ sources and a high dose-rate x-ray machine were available for radiobiological work in the Stockholm area in 1959. The radiation sources are described briefly. (C.H.)

1682 RISÖ-16(p.13-14)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

CHEMICAL DOSIMETRY AT RISÖ. Niels W. Holm.

A brief account is given of chemical methods of radiation dosimetry in use at the Research Establishment at Risö in 1959. (C.H.)

1683 RISÖ-16(p.15-16)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

DOSIMETRY OF RADIATIONS USED FOR FOOD PRESERVATION. G. Ahnström and L. Ehrenberg.

The usefulness of several radiation dosimetric methods is compared for use in connection with food preservation. Data are tabulated. (C.H.)

1684 RISÖ-16(p.17-20)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

CALORIMETRIC MEASUREMENTS OF GAMMA-RAYS IN THE Co-60 IRRADIATION FACILITY AT RISÖ. Ari Brynjólfsson.

An ice calorimeter was used to carry out accurate determinations of the dose in the Co^{60} γ irradiation facility at Risö. By using the same irradiation geometry, it was possible to measure the corresponding yield of oxidation in a standard Fricke dosimeter, thereby obtaining a very accurate calibration of this dosimeter. (C.H.)

1685 RISÖ-16(p.21-2)

Stockholm. Univ. Nobel Medical Inst.

NITRIC OXIDE TITRATION OF FREE RADICALS IN IRRADIATED MATERIALS. A. Ehrenberg, L. Ehrenberg, and G. Löfroth.

A method is described for the direct chemical determination of the number of free radicals in an irradiated sample of a solid substance. Nitric oxide was chosen as a suitable chemical agent. Preliminary experiments showed that the radicals in γ-irradiated crystalline cholesterol were very stable in vacuo. The radicals in irradiated cholesterol reacted promptly with NO. Using the calibration obtained by NO titration, the energy absorbed per formed radical was determined for some substances irradiated with γ doses of less than 1 M rad. The electron spin resonance of γ irradiated cholesterol in vacuo and after the addition of oxygen is plotted. (C.H.)

1686 RISÖ-16(p.23-4)

Pharmacia Ltd., Uppsala and Uppsala. Univ. Inst. of Physical Chemistry.

GAMMA RAY DEGRADATION OF DEXTRAN IN THE SOLID STATE. Kirsti Granath and Per-Olof Kinell.

Degradation data are tabulated for dextran samples irradiated by Co^{60} γ rays. The existence of long-lived free radicals in the irradiated material was demonstrated. (C.H.)

1687 RISÖ-16(p.25-6)

Stockholm. Univ. Nobel Medical Inst. and Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

CHEMICAL CHANGES PRODUCED BY IONIZING RADIATIONS IN SOLID CARBOHYDRATES. Preliminary Report. A. Ehrenberg, L. Ehrenberg, and G. Löfroth.

The electron spin resonance of γ irradiated glucoses and rehalose are plotted. Data indicate that closely related carbohydrates, when dissolved after irradiation, give rise to different reaction products. It is suggested that this might reflect chemical differences between the free radicals formed initially. (C.H.)

1688 RISÖ-16(p.27)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

FREE RADICALS AND BIOLOGIC RADIATION EFFECTS. Berndt Sparrman.

Results are reported from studies of the relationships between free radicals and biological damage. (C.H.)

1689 RISÖ-16(p.28-36)

Sweden. Kungliga Tekniska Högskolan, Stockholm.

SOME POINTS OF VIEW ON STORED ENERGY IN IRRADIATED FOOD. Torbjörn Westermark.

It is concluded that the property of stored energy is an important subject of study in relation to radiation preservation of all kinds. Indications have been found showing that dry solids can store large amounts of energy which act like radiation during dissolution. Little is known concerning moist substances in this respect. The relation between stored energy and free radicals has not been revealed but probably some connection exists. The stored energy can probably be released after the food irradiation preservation processes by heating or steam treatment. The formation of peroxides must then be considered. It is suggested that it may prove necessary to treat the substances after irradiation in certain ways in order to assure satisfactory wholesomeness of irradiated foods. (C.H.)

1690 RISÖ-16(p.37-8)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

DEGRADATION OF STARCH PRODUCED BY INDIRECT EFFECT OF γ-IRRADIATED GLUCOSE. G. Löfroth and L. Ehrenberg.

When carbohydrates are dissolved in water after irradiation in the crystalline state substances of still unknown character are formed. Some of the compounds formed are unstable and undergo more or less slow changes as visualized by the chemoluminescence of the solutions. A chemical reactivity of decomposition products of irradiated sugars (starch or glucose) has been demonstrated. Results are reported from an investigation of the possible biologic significance of the decomposition products of starch resulting from irradiated glucose solutions. Data are presented graphically. (C.H.)

1691 RISÖ-16(p.39-40)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

STORED ENERGY AND INDIRECT BIOLOGICAL EFFECTS OF RADIATION. A. T. Natarajan.

Results of studies on the genetic and cytological consequences of the indirect effects of radiations are reviewed. Data are presented from experiments on excised wheat embryos from germinated wheat seeds grown in a culture medium that had previously been irradiated and germinated barley seeds treated for 24 hours with an irradiated thymine solution. Results show that stored energy following irradiation can cause cytological disturbances in growing tissues. (C.H.)

1692 RISÖ-16(p.41-3)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

HOW SHOULD A POSSIBLE CARCINOGENIC ACTION OF IRRADIATED FOOD BE ESTIMATED? L. Ehrenberg and G. von Ehrenstein.

The influence of irradiated glucose on total leukocytes in rats was measured. A decrease on the second day following injection was observed which was similar to the response after irradiation of the animals. The possibility of a carcinogenic action of irradiated foods is discussed. (C.H.)

1693 RISÖ-16(p.44-6)

Denmark. Fiskeridepartementet. Teknologisk Laboratorium, Copenhagen.

THE EFFECT OF Co-60 IRRADIATION ON BACTERIA FROM FRESH FISH. Sten B. Halkier.

Results are reported from an investigation of the effects of various amino acid additives to growth media on the radiosensitivity of 57 strains of bacteria of marine origin. An attempt was made to determine whether or not the radiosensitivity of bacteria follows a mathematical pattern that would enable the prediction of a radiation dose for food sterilization. (C.H.)

1694 RISÖ-16(p.47-8)
Slagteriernes Forskningsinstitut, Roskilde, Denmark.
THE MICROFLORA OF CANNED HAM TREATED WITH COMBINATIONS OF HEAT PROCESSING AND IRRADIATION. Kirsten Warnöe and Niels-Henrik Hansen.

It was determined that the microflora which develops in canned hams treated with combinations of heat processing and irradiation is nearly of the same composition as a bacterial flora in normally heat processed canned hams. The composition of the microflora seems to be nearly the same whether irradiation doses of 0.1 Mrad or 0.2 Mrad are used. There is no indication that the treatment with ionizing radiation gives rise to the development of bacterial strains that are particularly resistant to irradiation. It may be that extremely resistant strains survive the combined treatment with heat and irradiation, but if this is the case; they seem to be unable to multiply in the hams during storage. (auth)

1695 RISÖ-16(p.49)
Svenska Institutet för Konserveringsforskning, Göteborg.
MODIFYING FACTORS FOR THE RESISTANCE OF BACTERIA AGAINST IONIZING RADIATION—SOME PRELIMINARY STUDIES. Jaan Teär.

Experiments are reported which were carried out to test the importance of modifying factors on the radiosensitivity of a number of marine bacteria occurring in preserved fish products. No results are included. (C.H.)

1696 RISÖ-16(p.50)
Sweden. Kungliga Tekniska Högskolan, Stockholm.
PRELIMINARY STUDIES ON BIOLOGICALLY ACTIVE VITAMIN B_{12}-FRAGMENTS OBTAINED BY EXPOSURE OF CYANOCOBALAMIN TO IONIZING RADIATIONS. L.-E. Ericson and Monica Sjöstedt.

Biologically active break-down products were obtained by irradiation of a solution of vitamin B_{12} under aerobic conditions at a pH of 5 in a phosphate buffer. Under other conditions of pH, buffer, and oxygen tension, different reactions occurred which resulted in the formation of vitamin B_{12} fragments having other characteristics than those mentioned above. Possible reaction mechanisms involved are discussed. (C.H.)

1697 RISÖ-16(p.51)
[Slagteriernes Forskningsinstitut, Roskilde, Denmark].
RADIATION PRESERVATION OF HAM, LUNCHEON MEAT, AND BACON. E. Stenberg Knudsen.

Results are reported from experiments on the effects of radiation treatment on the keeping qualities of canned hams, luncheon meat, and sliced bacon packed in polycel bags. Scores for taste and odor are presented graphically. (C.H.)

1698 RISÖ-16(p.53-4)
Slagteriernes Forskningsinstitut, Roskilde, Denmark.
THE KEEPING QUALITY OF CANNED HAM TREATED WITH COMBINATIONS OF HEAT PROCESSING AND IRRADIATION. Niels-Henrik Hansen and Kirsten Warnë.

Twelve hundred commercially packed hams in 12-oz cans closed under vacuum were treated with γ radiation in a cobalt facility at doses ranging from 0.1 to 1.2 Mrad The cans were cooked until the center temperatures reached 65 or 75°C. One-half of the cans were irradiated before the heat treatment and the other half after the heat treatment. Results are presented from tests on the keeping quality of the hams. It was found that a dose of 0.6 Mrad produced 100% commercially sterile cans. (C.H.)

1699 RISÖ-16(p.55-6)
Svenska Institutet för Konserveringsforskning, Göteborg.
SOME PRELIMINARY EXPERIMENTS IN USING IONIZING RADIATIONS FOR THE PRESERVATION OF SEMIPRESERVED FISH PRODUCTS. F. Alm, I. Erichsen, N. Molin, E. von Sydow, and J. Teär.

Results from a series of preliminary experiments on the effectiveness of radiation treatment for the preservation of semiprocessed fish products indicate that radiation doses that are effective against the microflora produce undesirable odors and flavors that reduce the acceptability of the product. Data are reported from studies of tins of anchovy, pickled herring, smoked salted salmon, and swollen and normal cans of gaffelbits. (C.H.)

1700 RISÖ-16(p.57-8)
Denmark. Fiskeridepartementet. Teknologisk Laboratorium, Copenhagen.
PRELIMINARY EXPERIMENTS ON RADIATION PRESERVATION OF FISH PRODUCTS. Sten B. Halkier.

Preliminary experiments on the effectiveness of the radiation preservation of iced or frozen fish fillet and codfish-roe caviar led to the conclusion that sterilizing doses of radiation result in off-flavors which reduce acceptability of the product. (C.H.)

1701 RISÖ-16(p.59-60)
Norges Veterinarhögskole, Oslo and Gt. Brit. Low Temperature Research Station, Radiation Group, Cambridge, England.
THE INACTIVATION OF THE TOXINS OF CLOSTRIDIUM BOTULINUM, TYPES A AND B, BY 4 MEV ELECTRONS. A. Skulberg and B. Coleby.

Clostridium botulinum toxin inactivation during irradiation was found to be exponentially related to the dose absorbed. Data are tabulated. Results are interpreted on the basis of a target theory. The radicals formed in the water presumably reacted mainly with extraneous organic solutes. (C.H.)

1702 RISÖ-16(p.61-4)
Denmark. Statens Forsögsmejeri, Hilleröd.
SOME STUDIES ON THE IRRADIATION OF DAIRY PRODUCTS. K. P. Andersen.

Experiments on the effects of γ irradiation on the storage life of pasteurized milk, butter, and various kinds of cheeses led to the conclusion that γ irradiation cannot be used directly for the purpose of preserving dairy products. Data are tabulated. (C.H.)

1703 RISÖ-16(p.65-6)
Norges Landbrukshögskole, Vollebekk.
RADIATION EXPERIMENTS WITH POTATOES AND OTHER PLANT PRODUCTS IN NORWAY. Knut Mikaelsen and Lars Roer.

Results are reported from experiments on the effects of radiation treatment on the storage life of potatoes, carrots, apples, and bananas. Moderate doses of γ radiation were effective in the inhibition of sprouting of potatoes and growth and weight loss in other root crops. Carrots kept well when they were washed and stored in plastic bags before irradiation. Apples and bananas kept better when irradiated while still green. A blackening of the skin followed irradiation of the bananas. The effects of irradiation on sprouting, weight loss, ascorbic acid content, and quality in potatoes were compared with the effects of treatment with a number of growth inhibitors. Gamma radiation

proved to be more effective than most chemical treatments, but was not superior to Potifar M (IPC) for the prevention of sprouting and improvement of storage quality. (C.H.)

1704 RISÖ-16(p.67-8)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

IRRADIATION OF POTATOES, ONIONS AND CARROTS TO INHIBIT SPROUTING. T. A. Truelsen.

Results are reported from a series of studies on the effects of radiation processing on the taste and storage life of potatoes, onions, and carrots. The potatoes were examined for sprout inhibition, color, and sugar content after exposure to various doses of radiation; the carrots were examined for sprouting and the development of rot; and the onions were examined for rot and for taste changes after cooking. (C.H.)

1705 RISÖ-16(p.69-70)

Denmark. Statens Forsögsstation, Studsgard.

ON WOUND HEALING IN GAMMA-IRRADIATED POTATOES. Johs. Bak Henriksen.

A decrease in the ability to form periderm by irradiated potatoes was related to a decrease in sprouting ability. The inhibition of wound-healing resulted in susceptibility to attack by fungi and bacteria following irradiation. (C.H.)

1706 RISÖ-16(p.70-2)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

EFFECTS OF IONIZING RADIATIONS ON INHIBITION OF SPROUTING AND BIOCHEMICAL AND PHYSIOLOGICAL CHANGES IN POTATO TUBERS. Maire Jaarma.

The irreversibility of radiation induced sprout inhibition of potatoes makes it more effective than chemical inhibition. Results are reported from an investigation of factors influencing the inhibition of sprouting. (C.H.)

1707 RISÖ-16(p.73-5)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

IRRADIATION OF FRESH FRUITS AND VEGETABLES WITH PASTEURIZING DOSES. T. A. Truelsen.

Results are reported from a series of preliminary studies on the effects of radiation processing on the flavor and storage life of strawberries, black currants, raspberries, cherries, apples, cauliflower, and tomatoes. It was concluded that irradiation can be expected to extend the conventional cold-storage period for these foods and in certain circumstances replace it. (C.H.)

1708 RISÖ-16(p.77)

Denmark. Tekniske Höjskole, Copenhagen. Laboratoriet for Industriel Udnyttelse af Frugt og Gröntsager.

IRRADIATION OF BERRYFRUIT WITH REFERENCE TO THEIR INDUSTRIAL UTILIZATION. Marius Jensen.

Experiments on applications of irradiation in the processing of berries led to the conclusion that applications of radiation are dependent on the proportion between wanted and unwanted effects. Radiation doses that destroy yeasts and molds decrease the quality of the products by causing distaste, discoloration, and deterioration of the consistency of the products. Data are tabulated on the effect of several radiation dosage levels on the color, number of yeast and molds, sugar, acid, vitamin content, pectate content, viscosity of juice, and amount of juice from block currants. Results from preliminary studies indicate that block currants contain protective substances against unfavorable radiation effects. (C.H.)

1709 RISÖ-16(p.79-83)

Denmark. Atomenergikommissionen. Forsögsinstitut, Risö.

MICROBIOLOGICAL STUDIES IN CONNECTION WITH IRRADIATION OF CARROTS. J. P. Skou.

Results of studies on the radiation processing of carrots led to the conclusion that microorganisms grow better on irradiated than on nonirradiated fruits and vegetables. The most sensitive organisms are killed and make way for saprophytes so that irradiated fruits and vegetables may be damaged or destroyed by organisms that have never previously been of practical significance. Boiled irradiated carrots were found to give a slower growth of microorganisms than boiled unirradiated carrots. (C.H.)

1710 RISÖ-16(p.85-6)

Stockholm. Univ. Inst. of Organic Chemistry and Biochemistry.

PROLONGATION OF THE SHELF-LIFE OF BREAD BY MEANS OF SURFACE OR VOLUME IRRADIATION. L. Ehrenberg and J. Steding.

Experiments to determine whether ionizing radiations will prolong the shelf-life of soft breads led to the conclusion that irradiation at fairly low doses is an excellent method for the pasteurization of bread and is acceptable as far as technical details are concerned. In some cases a surface irradiation is sufficient to prolong the shelf-life. (C.H.)

1711 TID-6550

Chicago. Univ. Chicago Midway Labs.

DETERMINATION OF INDUCED GAMMA-RAY ACTIVITY IN BEEF STERILIZED BY COBALT-60 IRRADIATION. Foster F. Rieke and John E. Brugger. Aug. 25, 1959. 9p. Contract AT(11-1)-712. OTS.

Compared to a nonirradiated control, no measurable difference was observed in the γ spectra of 4 lb of beef a day after the sample received a 10-megarad dose of Co^{60} radiation. The counts per minute for irradiated and nonirradiated were 121.02 ± 0.58 and 120.68 ± 0.58. (T.R.H.)

1712 TID-6700

Massachusetts Inst. of Tech., Cambridge.

OUTLINE OF PROJECTS TO DETERMINE THE FEASIBILITY OF RADIATION PRESERVATION OF MARINE PRODUCTS. Report No. 9183. J. T. R. Nickerson, S. A. Goldblith, S. A. Miller, J. J. Licciardello, and M. Karel. [1960?]. 87p. Contract AT(30-1)-2329. OTS.

Research projects on feasibility of radiosterilization of marine products are described. The separate projects deal with refrigerated storage-life extension of substerilized marine products, nutritional components of processed foods, packaging requirements, evaluation of hitherto uninvestigated species, consumer acceptability, and wholesomeness evaluation. (T.R.H.)

1713 AEC-tr-4206

HEAT ENGINEERING AND HYDRODYNAMICS. Volume IV. (Teplotekhnika i Gidrodinamika. Tom 4). M. A. Styrikovich, G. E. Kholodovskiĭ, and M. S. Fomichev, eds. Translated from Trudy Vsesoyuz. Nauch. Tekh. Konf. Primenen. Radioaktiv. i Stabil. Izotopov i Izluchenii v Narod. Khoz. i Nauke, 1957, 4 (Publ. 1958). 99p. OTS.

Abstracts were prepared for the 17 papers contained. The papers pertain to studies on steam engineering and tracer techniques. (C.J.G.)

1714 AEC-tr-4206(p.1-7)

MEASURING THE VOLUMETRIC CONTENT OF STEAM-GENERATING ELEMENTS BY MEANS OF GAMMA RADIATION. Z. L. Miropl'skiĭ and R. I. Shneyerova.

The measurement of the average volumetric steam content in tubes of a steam-water circuit by a γ-radiation technique is described. (C.J.G.)

1715 AEC-tr-4206(p.8-11)

UTILIZATION OF GAMMA RADIATION IN THE STUDY OF

THE BUBBLING PROCESS. G. G. Bartolomei, Ya G. Vinokur, V. A. Kolokol'tsev, and V. I. Petukhov.

A γ-radiation technique for studying bubble formation in the boiling process is described. The distribution of steam and liquid phases in a volume under different conditions of bubbling was determined. (C.J.G.)

1716 AEC-tr-4206(p.12-15)
UTILIZATION OF THE GAMMASCOPE METHOD OF STUDYING THE HYDRODYNAMIC REGIME OF A LIQUID–LIQUID SYSTEM. S. S. Kutateladze and V. N. Moskvicheva.

A gamma technique for studying the basic characteristics of a two-component flow is described. The hydrodynamic characteristics of a mercury-water system were determined. (C.J.G.)

1717 AEC-tr-4206(p.16-20)
TAGGED ATOM METHOD OF INVESTIGATION OF WATER AND STEAM CONTENT DURING SURFACE BOILING OF A LIQUID. P. G. Poletavkin and N. A. Shapkin.

A tracer technique is described using NaF containing Na^{24} for investigating the water and steam content of a liquid during surface boiling. (C.J.G.)

1718 AEC-tr-4206(p.21-8)
DETERMINATION OF SPECIFIC SURFACE OF QUARTZ AND CEMENT POWDERS BY THE SORPTION METHOD WITH THE USE OF TAGGED ATOMS. V. S. Kudryavtsev (Kudryavtseff).

The specific surfaces of quartz and cement powders were determined using a tracer technique. Sorption curves for strontium, calcium, cesium, and cobalt on cement are presented. (C.J.G.)

1719 AEC-tr-4206(p.29-34)
USE OF RADIOACTIVE ISOTOPE S^{35} IN THE STUDY OF SULFATE CORROSION OF CONCRETE. V. M. Moskvin and I. I. Kurbatova.

The corrosion of concrete by a 5% solution of Na_2SO_4 was studied using S^{35} as a tracer element. Distribution of the sulfate ion was investigated. (C.J.G.)

1720 AEC-tr-4206(p.35-40)
METHODS OF DETERMINING SOIL DENSITY AND MOISTURE CONTENT BY MEANS OF RADIOACTIVE IRRADIATION. N. A. Tsytovich, V. I. Ferronskiĭ, and V. A. Lukin.

A γ-irradiation technique is described for determining the density and moisture content of soils. Probes for this type of work are described. (C.J.G.)

1721 AEC-tr-4206(p.41-3)
STUDY OF MIGRATION PROCESSES OF MOISTURE IN CONSTRUCTION MATERIALS BY THE GAMMASCOPE METHOD. L. G. Polozova and R. P. Reizman.

A method of determining the moisture content of structural materials by γ-irradiation is described. (C.J.G.)

1722 AEC-tr-4206(p.44-8)
USE OF RADIOACTIVE ISOTOPES FOR INVESTIGATING SOLUBILITY OF SALTS IN WATER VAPOR OF LARGE PARAMETERS. M. A. Styrikovich, I. Kh. Khaibullin, and L. K. Khokhlov.

The solubilities of Na_2SO_4, $CaSO_4$, NaCl, $CaCl_2$, and $CaCO_3$ in water vapor at 350 to 650°C were investigated using tracer techniques. (C.J.G.)

1723 AEC-tr-4206(p.49-54)
INVESTIGATION OF THE QUALITY OF STEAM UNDER A PRESSURE OF 185 abs atm BY MEANS OF RADIOACTIVE ISOTOPES. L. S. Sterman, A. Ya. Antonov, and A. V. Surnov.

The moisture entrainment of steam under a pressure of 185 absolute atm. was studied by tracer techniques. (C.J.G.)

1724 AEC-tr-4206(p.55-9)
USE OF RADIOACTIVE ISOTOPES FOR OBSERVING THE FLOW OF MOLTEN GLASS IN GLASS FURNACE TANKS. V. A. Dubrovskiĭ.

A tracer technique using Ca^{45} was developed to determine the direction of flow of molten glass in glass furnace tanks. (C.J.G.)

1725 AEC-tr-4206(p.60-4)
USE OF RADIOACTIVE ISOTOPES FOR THE STUDY OF FILTRATION OF LIQUIDS THROUGH POROUS MEDIA. V. V. Rachinskiĭ.

The motion of a liquid during filtration through porous media was studied by means of a tracer technique. The velocity of the front of the solution and the distribution of the tagged water were investigated in sand and the ion-exchange resin KU-2. (C.J.G.)

1726 AEC-tr-4206(p.65-9)
RADIOACTIVE METHODS OF STUDYING THE PROCESSES OF A LIQUID FLOW IN A POROUS MEDIUM. D. I. Leipushinskaya and Ya. A. Pruslin.

The study of flow processes in hydrodynamic models by tracer techniques is discussed. The characteristics of the displacement of kerosene by kerosene and by water were investigated. (C.J.G.)

1727 AEC-tr-4206(p.70-5)
A STUDY OF THE HYDRODYNAMICS OF A LIQUID IN THE CONICAL ROTOR OF A PRECIPITATION CENTRIFUGE BY MEANS OF RADIOACTIVE ISOTOPES. M. A. Borts, L. S. Zarubin, V. S. Kaminskiĭ, and L. L. Ĭorsak.

1728 AEC-tr-4206(p.76-81)
RESEARCH ON THE MOTION OF WATER IN PEAT UNDER LABORATORY AND FIELD CONDITIONS BY MEANS OF RADIOACTIVE ISOTOPES. M. P. Volarovitch, N. V. Churaev, and B. A. Minkov.

The flow of water in peat was investigated under field and laboratory conditions by a tracer technique using S^{35} in a solution of Na_2SO_4. (C.J.G.)

1729 AEC-tr-4206(p.82-8)
APPLICATION OF RADIOACTIVE ISOTOPES FOR INVESTIGATING SUSPENDED SEDIMENTS IN RIVERS. M. M. Arkhangel'skiĭ.

Tracer techniques were used to study the distribution of suspended sediments in rivers. Characteristic values of light attenuation and γ-ray absorption by the suspended particles were determined. (C.J.G.)

1730 AEC-tr-4206(p.89-94)
APPLICATION OF RADIOACTIVE ISOTOPES FOR STUDYING THE MECHANISM OF THE PROCESS OF DRYING. A. I. Veinik and A. S. Shubin.

Tracer techniques were developed to study the mechanism of the phase transformation of moisture in the process of drying for both stationary and nonstationary cases. (C.J.G.)

1731
UTILIZATION OF RADIOISOTOPES AND NUCLEAR RADIATION IN THE STUDY OF FLOTATION PROCESSES. Igor Nikolaevici Plaxin. Acad. rep. populare Romîne, Studii cercetări met. 5, 229-48(1960). (In Rumanian)

The classical research methods are insufficient to define the effect of an entire series of factors on the development of flotation processes. A more profound study was made possible by the utilization of radioisotopes. The principle results of studies made on flotation using radioisotopes are presented. The distribution of reactants on

the surface of particles of mineral substances, the interaction of reactants with the minerals, and the effect of various factors (pH of the pulp and presence of certain ions) on the adsorption of the reactants at the surface of the minerals were determined. (tr-auth)

1732

RADIATION PRESERVATION OF FOODS. H. E. Robinson and W. M. Urbain. J. Am. Med. Assoc. 174, 1310-11(1960) Nov.

The use of radiation has shown great promise as a means of preserving food. Procedures used in radiation processing, changes in foods induced by radiation, and safety problems involved in the radiation processing of foods are reviewed. (C.H.)

1733

THE PERMISSIBLE AMOUNTS AND USE OF RADIOACTIVE COBALT FOR DETECTING BLAST-FURNACE LINING WEAR. A. Metcalf (Plessey Nucleonics, Northampton, Eng.). J. Iron Steel Inst. (London) 194, 360-3 (1960) Mar.

An account is given of the use of Co^{60} in the assessment of blast-furnace lining wear, and the potential resultant contamination of steel is evaluated. Details are presented of experimental work on the fogging of fast x-ray film by exposure to steel contaminated with Co^{60}. Recommendations are developed as to desirable upper limits of contamination. It is concluded that contamination of steel should not be allowed to exceed 20 μc/ton and should in addition be restricted to a modest percentage of steel output. (auth)

1734

LES TRACEURS RADIOACTIFS EN MÉTALLURGIE PHYSIQUE. (Radioactive Tracers in Physical Metallurgy). C. Leymonie. Paris, Dunod, 1960. 233p.

Chapter I is devoted to generalities such as radioisotopes, properties of radiations and decays, detection of radiations and decays, and radioactive tracers in metallurgy. Chapter II discusses intermetallic diffusion, methods of diffusion study using tracers, intergranular diffusion, surface diffusion, diffusion of certain metalloids in metals, and diffusion in liquid metals. Chapter III, on segregation, deals with segregation in melts, fusion of grain joints, segregation in the solid state, modification of Al–Si alloys, and preferential distribution of sulfur during the loading of iron with cathodic hydrogen. Chapter IV, Surface Reactions and Mechanisms, has sections on exchange and displacement between a metal and an ionic solution, corrosion and inhibition, oxidation and sulfidation of metals, and friction and wear. The final chapter treats equilibria of a vapor and a condensed phase and equilibria in slags. Extensive bibliographies are included with each chapter, totaling 270 references. (T.R.H.)

ISOTOPE SEPARATION

1735 CF-53-11-47(Del.)

Oak Ridge National Lab., Tenn.

DETERMINATION OF THE LITHIUM ISOTOPIC SEPARATION FACTOR BY ION EXCHANGE IN THE SULFONATED POLYSTYRENE RESIN–LITHIUM CHLORIDE SYSTEM. R. E. Blanco, A. H. Kibbey, J. F. Land, and J. T. Roberts. Nov. 4, 1953. Decl. with deletions June 10, 1960. 18p. OTS.

The ion-exchange separation factor for Li^6 and Li^7 isotopes was determined to be 1.0027 with a 95% confidence-level range of 1.0015 to 1.005 by batch equilibrating lithium form Dowex 50W resin with an aqueous solution of lithium chloride. Fifteen successive equilibrations were made. (auth)

1736 TID-6471

Oak Ridge Gaseous Diffusion Plant, Tenn.

CHEMISTRY RELATED TO THE ISOTOPIC SEPARATION OF TUNGSTEN BY GASEOUS DIFFUSION. Karl E. Rapp. Oct. 6, 1959. 8p. (KL-581(Rev.)). OTS.

A summary of processing technology for production of WO_4 and WF_6 is presented. Because of its low capture cross section, W^{184} was suggested as UO_2 fuel-element-container material. Properties of WF_6 indicate that an economical separation of the isotope by gaseous diffusion may be possible. (J.R.D.)

1737

VAPOR/LIQUID PARTITION OF TRITIUM IN TRITIATED WATER. O. Sepall and S. G. Mason (Pulp and Paper Research Inst. of Canada, Montreal and McGill Univ., Montreal). Can. J. Chem. 38, 2024-5(1960) Oct.

The ratios of isotopic concentrations H^3/H^1 in the saturated vapor and liquid phases of tritiated water were determined for the temperature range from 0 to 90°C. The values of the ratio varied from 0.86 to 0.97. The results were reproducible for distillation times of 30 min or longer. (M.C.G.)

1738

A METHOD FOR THE ENRICHMENT OF RADIOISOTOPES PRODUCED BY (γ,n). I. G. Almeida and L. Marquez (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). J. Inorg. & Nuclear Chem. 15, 18-19(1960) Sept. (In English)

A method was developed to enrich radioisotopes produced by (γ,n) reactions based on catching the recoils from the finely divided material in a solidified phase of 20% by weight gelatine in water. The method was applied to titanium and copper, giving enrichment factors of 100 and 4.0, respectively. (auth)

1739

SEPARATION OF BORON ISOTOPES. O. V. Uvarov, N. M. Sevryugova, and N. M. Zhavoronkov (Karpov Inst. of Research of Physical Chemistry, Moscow). Kernenergie 3, 866-8(1960) Sept. (In Russian)

Several methods for the separation of boron isotopes are compared from the economy point of view. Some separation plants are described. (auth)

MATHEMATICS AND COMPUTERS

1740 APEX-574

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

NUCLEAR DATA TAPE PROGRAM (IBM 704 PROGRAM NDTP). K. A. Paine. Dec. 1957. 31p. Contracts AF33(600)-38062 and AT(11-1)-172. OTS.

The Nuclear Data Tape Program (NDTP) compiles, from certain minimal input data, a tape containing nuclear data used by GE-ANPD reactor-analysis programs C_4, C_5, G_2, and George on the IBM 704 computer. Provision is made for listing the tape, punching binary cards from which a new tape can be made, modifying a record, adding new records, adding a modified record, or omitting a record. (auth)

1741 CF-60-3-48(Add.)

Oak Ridge National Lab., Tenn.

IBM 704 GAUSSIAN-INTEGRATION ROUTINES. M. P. Lietzke. Oct. 11, 1960. 3p. OTS.

The Gaussian-integration subroutines GINT1, GINT2, and GINT3 were rewritten to facilitate simultaneous

integration of several functions over the same range; the new routines are FORTRAN II subroutines rather than functions. The number of function-evaluating routines was reduced from 9 to 3. The calling sequence for the new routines is presented. (C.J.G.)

1742 CWR-400-24
Curtiss-Wright Corp. Research Div., Quehanna, Penna.
TABLES OF THE INCOMPLETE ELLIPTIC INTEGRALS OF THE FIRST AND THIRD KIND. F. A. Paxton and J. E. Rollin. June 1, 1959. 435p.

Tables of the incomplete elliptic integrals of the first and third kind are presented. The integrals were evaluated using Simpson's Rule. The mesh size in Simpson's rule was halved until two successive sums of the integral agreed with 0.000001. A value greater than the maximum absolute value attained by the function on the interval was required for initializing; this value was assumed to be 10^{35}. (C.J.G.)

1743 LA-2451
Los Alamos Scientific Lab., N. Mex.
THEORY OF ANGULAR MOMENTUM IN N-DIMENSIONAL SPACE. James D. Louck. May 1, 1960. 293p. Contract W-7405-eng-36. OTS.

The commutation relations for angular-momentum components in an N-dimensional Euclidean space are defined, and a set of independent mutually commuting angular-momentum operators is constructed. The simultaneous eigenvectors of these commuting operators are chosen as basic eigenvectors to obtain the matrix representations of the angular-momentum components. The eigenvalues of the commuting operators are found. The position of orbital angular momentum with respect to the general theory is illustrated. The eigenvalues of the N-dimensional isotropic harmonic oscillator Hamiltonian and the matrix representations of the coordinates and conjugate linear momenta of the oscillator are derived in the representation which diagonalizes the orbital angular momentum operators. Matrix methods are employed. (auth)

1744 LMSD-288088(Vol.II)
Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.
GENERAL RESEARCH IN DIFFRACTION THEORY. VOLUME 2. SUPPLEMENTARY TABLES AND FIGURES RELATED TO A CLASS OF DIFFRACTION INTEGRALS. Nelson A. Logan. Dec. 1959. 281p. OTS.

Tables and figures are presented to supplement the theoretical results presented in the first volume of this series. The functions tabulated can be used to study diffraction effects when source and receiver are on the surface, source or receiver is on the surface and the receiver or the source is at a great distance, and both source and receiver are at a great distance. (auth)

1745 RM-2552(RAND)
RAND Corp., Santa Monica, Calif.
APPROXIMATE CONFIDENCE LIMITS FOR THE RELIABILITY OF SERIES AND PARALLEL SYSTEMS. Albert Madansky. Apr. 4, 1960. 13p. Contract AF49(368)-700.

A method for combining data on individual component reliability to determine approximate confidence limits for the reliability of complete mechanisms is presented. It is assumed that the failures are independent and that failures of a given component follow a binomial distribution with unknown parameter (the component reliability). The large-sample properties of the likelihood-ratio test are then used to construct the appropriate confidence limits for the system reliability. (auth)

1746 TID-6495
Illinois. Univ., Urbana. Digital Computer Lab.
SUMMARY TECHNICAL PROGRESS REPORT. Aug. 30, 1960. 373p. Contract AT(11-1)-415. OTS.

The design for the arithmetic unit for the high-speed computer is complete. Circuit drawings and wiring schematics for repetitive parts of the main unit are presented. Static current-voltage curves are presented for the stabistors. Design specifications are presented for transistors and transitron diodes. Design studies are presented on emitter followers; bleeder, matrix logic, and driver circuits; switching amplifier; and collector logic as applied to F-element design. Limitations on the cascading of nonrestoring circuits are discussed. The theory of computer arithmetic employed in the computer is discussed. A description of the arithmetic control is given in terms of the sequences of selectors and gates required for each order, together with the end connections and Boolean functions required. A 64-word test model of the core memory was constructed; a description of this model is contained. The auxiliary memory of the computer will contain 4 magnetic tape transports and drum memories with a 65,536-word capacity. The magnitude of dropout (loss of signal from the magnetic tape owing to defective magnetic material, or dust or oxide lifting the tape from the head) was investigated to determine how much redundancy needs to be added to the magnetic tape signal to achieve satisfactory reliability. The problems of optimizing the number of tracks on the tape, the number of words per block, the packing density, and the tape speed were studied. (See also AECU-4660.) (C.J.G.)

1747 YAEC-141
Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.
PRESTO—A PRESSURIZER TRANSIENT PROGRAM FOR THE IBM-704. J. P. Cunningham and H. R. Meyer. Aug. 1960. 146p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

Presto, a code written for the IBM 704 to represent the transient operation of a steam pressurizer, is described. Volume in the pressurizer is divided into a steam region and three arbitrarily defined water regions with variable boundaries; the metal container is divided into corresponding regions to facilitate heat-transfer calculations. Mechanisms considered include mixing of surge water with water in the pressurizer, boiling, condensation, heat transfer, pressure drop across the surge pipe, and the control functions of heaters, spray, relief valves, and an external feed and bleed system. The code is designed to accommodate a wide variety of assumptions regarding these phenomena, which must be incorporated in the input data. Input information tabulated as functions of time includes either the volume surge rate into the pressurizer or the net heat flow to the coolant system producing the surge, as well as coolant temperature at the surge pipe inlet and enthalpy of spray entering the pressurizer. A fourth-order Runga-Kutta method is used to solve numerically the differential equations involved. (auth)

1748 AEC-tr-4185
LOVOZERO AND KHIBINA MASSIFS -- A RARE-METAL BIOGEOCHEMICAL PROVINCE. (Lovozerskii i Khibinskii Massivy—Redkometal'naya Biogeokhimicheskaya Provintsiya). A. A. Dudykina and E. I. Semenov. Translated from Trudy Inst. Mineral. Geokhim. i Kristallokhim. Redkrikh Elementov No. 1, 35-7(1957). 5p. JCL or LC.

The Lovozero and Khibina nephelinic-syenite massifs are rich in minerals containing large amounts of Zr, Ti,

Nb, Be, and rare earths. Plant specimens were collected, ashed, and analyzed by a quantitative spectral method. Seven elements were determined in the plant samples: Ti, Nb, Zr, Be, La, Y, and Sr. Soil samples were also analyzed, and the results are reported. (W.L.H.)

1749 AEC-tr-4186

GEOCHEMISTRY OF THE KHIBINA ALKALINE MASSIF. (K Geokhimii Khibinskogo Shchelochnogo Massiva). L. S. Borodin. Translated from Trudy Inst. Mineral. Geokhim. i Kristallokhim. Redkikh Elementov No. 1, 23-34(1957). 13p. JCL or LC.

The following problems of the general geochemistry of the Khibina Massif were investigated: average quantitative composition of the Massif, dissemination of certain dispersed elements in rocks and minerals, and classification of elements of the Khinina Complex according to their geochemical role in rocks and pegmatites. (W.L.H.)

1750 IGRL-T/R-97

SOME RUSSIAN WORK ON THE APPLICATION OF FUNCTIONAL ANALYSIS TO DIFFERENTIAL EQUATIONS. S. L. Sobolev. Translated by E. G. Peters from Czechoslov. Math. J. 6, 289-310(1956). 22p.

The solution of equations with partial derivatives by means of functional analysis is discussed. Emphasis is placed on immersion theories that deal with the properties of function spaces. Applications of the immersion theorems were made to the solution of equations of the elliptical type with partial derivatives. (C.J.G.)

1751 UCRL-Trans-557(L)

DESCRIPTION OF SOLUTIONS OF A SYSTEM OF DIFFERENTIAL EQUATIONS BY LIE SERIES. Wolfgang Gröbner. Translated from Arch. math. Logik u. Grundlagenforsch. 9, 82-93(1958). 20p. JCL.

The Lie series was first used to describe finite transformations of continuous transformation groups. It is shown that the Lie series converge and therefore represent analytical functions of a complex variable t, which satisfy the given system of differential equations and in which regular points can be analytically continued. (W.L.H.)

1752

REMARKS ON A SUMMATION METHOD OF THE PERTURBATION THEORY. M. Demeur and Ch. Joachain (Université Libre, Brussels). Bull. classe sci., Acad. roy. Belg. (5) 46, 225-32(1960). (In French)

The summation method developed by Dalgarno and Lewis has been extended to degenerate states. The limitations and some simplifications of the method are examined. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

1753 GEAP-3332

General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.

PREPARATION OF SELF BONDED BORIDES. Earl W. Hoyt and Juan Chorne. June 6, 1960. 16p. Contract AT(04-3)-189. OTS.

A study is being made of the stability, helium retentivity, and crystallographic changes in selected borides resulting from the $B^{10}(n,\alpha)Li^7$ reaction. The particular metal borides being investigated are: VB_2, TiB_2, HfB_2, ZrB_2, B_4C, YB_4, SmB_6, EuB_6, and YB_6. The study includes irradiation of the pure borides in three forms: as powders, as polycrystalline solids, and as single crystals. Elemental boron is also being studied for comparison with the borides. (W.L.H.)

1754 HW-58299(Rev.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CARBON STEEL FOR THE HANFORD NEW PRODUCTION REACTOR. W. D. Gilbert, N. R. Miller, W. J. Gartin, W. R. Conley, J. M. Fox, Jr., and L. D. Perrigo. Nov. 26, 1958. 17p. Contract W-31-109-Eng-52. OTS.

Results of a comprehensive program directed toward obtaining and evaluating appropriate technology to establish the feasibility of using carbon steel as the primary material for fabrication of the New Production Reactor (NPR) coolant system are presented. (J.R.D.)

1755 NMI-2088

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for August 1960. Sept. 30, 1960. 27p. Contract AT(30-1)-1565. OTS.

Progress is reported on the development of the hot-extrusion technique for UO_2. The primary object was to improve the technique sufficiently to permit fabrication of enriched fuel for irradiation. Preliminary forming studies are in process to determine the feasibility of making dimpled sheet and/or honeycomb type fuel elements. A program is reported to investigate fabrication methods for yttrium metal which will lead to improved products quality and to significant cost reductions in the fabrication of hardware. The collection and assessment of information pertinent to the design of a plant to fabricate ThO_2 fuel elements containing up to 5% U^{233} is continuing in the three categories: plant input, fuel fabrication, and plant output. The behavior of β-phase uranium during neutron irradiation under conditions that would cause gross swelling in α uranium is being evaluated. Work was begun on plans for the construction of the necessary modifications to the 100-ton vertical extrusion press to allow the extrusion of beryllium from a container filled with molten lead at 900°F. The extrusion press ram will apply force to the lead. The force will be transmitted hydrostatically to the beryllium and cause the beryllium to extrude. The billet will be designed in such a manner as to cause a progressively increasing reduction ratio as the billet extrudes. An investigation into the mechanism of the corrosion of zirconium alloys in high-temperature steam, with emphasis on the role of intermetallic precipitates, is reported. Alloys of Be–Co and Be–Mn were examined by thermal analysis. Preparation of a billet of beryllium-8 at. % Nickel for hot extrusion was begun. (For preceding period see NMI-2087.) (W.L.H.)

1756 NMI-2089

Nuclear Metals, Inc., Concord, Mass.

FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report for September 1960. Oct. 21, 1960. 28p. Contract AT(30-1)-1565. OTS.

Progress during the month on hot-extrusion techniques for UO_2 is described along with research on fabrication of nuclear fuel elements in thin gage sheets. In other areas, a program to develop economical fabrication procedures, will lead to improved product quality, is outlined. One unenriched uranium-0.3 wt. % chromiun and three 10% U^{235}-enriched castings were produced along with a uranium-0.3 wt. % chromium-0.3 wt. % molybdenum billet. These

billets were extruded and sliced into samples for study. Results of metallographic examinations of these castings revealed that both the unenriched and enriched binary alloys were completely α, whereas the enriched ternary alloy was all β. Results on fabrication of billets, dies, and rams for the hydrostatic extrusion of beryllium in molten lead at 900°F revealed problem areas, which are being investigated. A program of research into the mechanism of zirconium corrosion in steam is outlined. In beryllium research preparation and thermal analysis of binary beryllium alloys was continued. Data on β-phase alloys are included along with phase study information on these alloys. (J.R.D.)

1757 NYO-9058

Sanderson and Porter, New York.

FUEL ELEMENT DEVELOPMENT PROGRAM FOR THE PEBBLE BED REACTOR. Quarterly Progress Report [for] February 1 to April 30, 1960. Decl. May 23, 1960. 85p. Contract AT(30-1)-2378. OTS.

Emphasis was shifted in the Pebble Bed Reactor (PBR) Fuel Element Development Program from coatings on the sphere surface to coatings on individual fuel particles as the major deterrent to fission-product leakage. In a high-level irradiation test, cracks developed in the coatings of specimens coated with pyrolytic carbon and siliconized silicon carbide. In another high-level irradiation test, a graphite sphere fueled with Al_2O_3-coated UO_2 particles is showing excellent fission-product retention. The leakage factors for long-lived volatile fission products such as Kr^{85m}, Kr^{87}, Kr^{88}, Xe^{133}, and Xe^{135} are ranging from 10^{-9} to 10^{-6}. If this degree of fission-product retention is maintained in a large power reactor, it would result in essentially a "clean" primary loop. A simple crack in a fuel-element surface coating will permit the release of all of the volatile fission products in that specimen except those retained by the fuel particles. In view of the failures in surface-coated specimens tested to date, it appears to be a difficult task to ensure coating integrity in a large number of specimens because of their low thickness-to-diameter ratio and exposure to external loads on the fuel element. The test of a single specimen fueled with coated particles takes on added statistical significance, since about 500,000 "fuel elements" are actually being tested. The acceptability of graphite as a fuel-element matrix material was demonstrated when four types of graphite fueled with UO_2 suffered no significant deterioration in structural properties after irradiation to about 6000 kwh which is above the present design objective of the 125 Mw(e) PBR. Thus the incorporation of coated fuel particles, having excellent fission-product retention, into a graphite sphere, having excellent structural properties, offers a simple, rugged fuel element capable of producing high coolant temperatures while retaining most of the fission products. It is this type of fuel element which will receive major emphasis during the remainder of the PBR Fuel Element Development Program. The study of the preparation of graphite blanket elements loaded with ThO_2 by the thorium nitrate infiltration process was completed. It was found that graphite densities below 1.45 g/cc and more than five infiltration steps were required to achieve the desired ThO_2 loading. A study of the use of natural graphite to produce high-density graphite bodies was started. Densities greater than 2.0 g/cc were produced in a single pressing. The design and construction of an in-pile loop to study fission-product behavior in a recycled helium stream were continued. (For preceding period see NYO-9057.) (auth)

1758 OMRO-Publ-19

Watertown Arsenal. Materials Research Lab., Mass.

A REVIEW OF MATERIALS RESEARCH FOR 1959 OF THE ORDNANCE MATERIALS RESEARCH OFFICE. Irving Kahn and Frank S. Hodi. Mar. 1960. 52p. (AD-235054).

A total of 128 abstracts from previously published papers is presented on research developments in adhesives, organic and inorganic coatings, corrosion studies, metals and high-temperature materials, nondestructive testing, solid-state physics, plastics, rubber, and welding. (C.J.G.)

1759 ORO-326

National Carbon Co., Fostoria, Ohio.

FUEL CYCLE DEVELOPMENT PROGRAM. Monthly Newsletter [for] August 1960. R. L. Robinson. Sept. 30, 1960. 8p. Contract AT(40-1)-2560. OTS.

Progress is reported on UO_2 dispersion, typical trace impurity content in TS-160 fueled graphite, health hazards during high-temperature processing, special furnace for migration studies, photometric determination of uranium in U–graphite fuel elements, post irradiation examination of fueled graphite cylinder from ORNL-MTR-48-1, and irradiation experiment ORNL-MTR-48-2. (For preceding period see TID-6463.) (T.R.H.)

1760 WCAP-1545

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

THERMOELECTRIC NUCLEAR FUEL ELEMENT QUARTERLY PROGRESS REPORT [FOR] JANUARY-MARCH 1960. W. P. Blankenship, P. V. Mitchell, and S. W. Sandberg. Apr. 10, 1960. 63p. Contract AT(30-3)-500. OTS.

Materials preparation work was concentrated on sulfide, selenide, and telluride compounds of uranium, together with contact materials problems associated with these compounds. The uranium tellurides display an unsatisfactorily low Seebeck coefficient. Encouraging results were secured from the uranium-tellurium-sulfur and uranium-tellurium-selenium compounds. Of the possible materials for contacts, iron and palladium gave encouraging results in withstanding the attack of fumes emanating from the thermoelectric compounds in operation. Nichrome contacts and nickel-arsenic contacts resisted attack to a fair degree in the presence of selenium. A correlation between the hot-pressed density and the chemical composition of good thermoelectric pellets appears to be emerging; it may become a valuable guide in future work. Three in-pile experiments were performed. Two (in WTR) were thermoelectric elements, one fission-fired and one with an externally energized rod heater. The latter demonstrated the feasibility of making thermal conductivity measurements in a high-flux reactor. The third experiment, at BNL, involved irradiation of samples of 3M P-type lead telluride and lithium-nickel-oxide. Fabrication involved studies of: compatibility of potential cladding materials with lead telluride and germanium telluride; the effect of service-cycle type heating schedules on the thermoelectric properties of lead telluride and germanium telluride; the reliability of rod- and plate-type elements of these two materials, based on bench tests of electrically heated prototype elements; and a multijunction element arranged for an output potential in excess of one volt. (See also WCAP-1245.) (auth)

1761 AEC-tr-4226

THERMODYNAMICS AND KINETICS OF SINTERING. Herbert J. Oel. Translated from Z. Metallk. 51, 53-8 (1960). 13p. JCL.

Experiments with model bodies and powders which are intended to contribute to an understanding of the sintering process in one-component systems are described. Model experiments indicate that plastic flow, recrystallization, and inner stresses can be of considerable importance to

the initial progress of sintering. In sintering the tested loose powder, it was found that a simple transport mechanism alone is inadequate to describe material transport; instead, several successive and parallel processes are involved. Various measuring methods for determining the reactivity of a powder with regard to sintering are reported and compared. (auth)

1762

STUDY OF THE ELECTROCHEMICAL PROPERTIES OF THE SYSTEM POTASSIUM FLUOTITANATE–SODIUM CHLORIDE–TITANIUM DIOXIDE. I. P. Bardin and A. A. Kazaĭn. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 3-8(1960) July-Aug. (In Russian)

The K_2TiF_6–NaCl–TiO_2 system containing 0.05 to 3% TiO_2 was investigated by determining the polarization curves of the molten salt mixtures using a silver reference electrode. At the start of the electrolysis sodium is deposited out of the melt, reducing in turn the TiF_6^{-2} to elementary titanium. This results in a lowering of current density, followed by the cessation of sodium deposition. The anode process was not studied satisfactorily. (TTT)

1763

ELECTROLYSIS OF TITANIUM DIOXIDE IN MOLTEN SALTS. N. I. Anufrieva and A. I. Ivanov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 9-14(1960) July-Aug. (In Russian)

Various titanium oxides, especially TiO_2, were electrolyzed in molten cryolite at 950°C at current densities from 0.5 to 3.0 amp/cm^2, resulting in the deposition of an alloy containing usually 7 to 12% and occasionally up to 30% titanium on the molten aluminum electrode. Metallographic tests revealed the presence of the $TiAl_3$ phase in the melt. If the titanium content is higher than 10%, the precipitated alloy is usually solid. Tests were also made with chloride melts, such as KCl–NaCl and $CaCl_2$–$BaCl_2$–NaCl. It was demonstrated that it is feasible to prepare metallic titanium under the experimental conditions. The reaction mechanism involves the discharge of the Ca^{2+} ions at the cathode, followed by a partial redissolution of the element in its molten chloride, then reducing the suspended oxide to elementary titanium. (TTT)

1764

ELECTROLYSIS OF TITANIUM TETRACHLORIDE IN MOLTEN CHLORIDE SALT MIXTURES. V. G. Gopienko and A. I. Ivanov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 15-25(1960) July-Aug. (In Russian)

Electrolysis of $TiCl_4$ dissolved in molten salt mixtures of alkali and alkaline-earth chlorides indicated the feasibility of preparing metallic titanium by this method. Best results were obtained in mixtures of KCl–NaCl–20% $MgCl_2$ at temperatures ranging from 650 to 750°C and in a mixture of 30% $CaCl_2$–25% $BaCl_2$–45% NaCl at current densities up to 5 amp/cm^2. The cathodically deposited metal contained 92 to 99% titanium and impurities of iron, silicon, aluminum, and carbon from the container walls and the graphite anode. By electrolyzing $TiCl_4$, dissolved in an $AlCl_3$–NaCl melt, a Ti–Al alloy was obtained. The harmful impurities, such as oxygen, nitrogen, hydrogen, and carbon were kept within acceptable limits for the technical metal. (TTT)

1765

STUDY OF THE ELECTROCHEMICAL DECOMPOSITION OF TITANIUM ALLOYS. V. I. Lukashin, V. A. Reznichenko, and A. D. Khromov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 29-32(1960) July-Aug. (In Russian)

The electrochemical behavior of aluminum in an Al–Ti alloy system and the effect of silicon and other impurities on the mass transport phenomena were investigated in an electrolyzing apparatus having a nickel wire basket as anode, a Ti–Al alloy as cathode, and a NaCl solution containing lower oxides of titanium as the electrolyte. Using low current densities and low aluminum contents in the alloy, up to 4.2%, the aluminum is carried over only to a slight extent into the cathodic deposit. It was demonstrated that pure titanium can be obtained with aluminum contents up to 40% under special conditions. The presence of impurities, which stabilize the β-phase, was found to be helpful for preparing a high-grade product. Use of silicon for the metallothermic preparation of raw titanium is harmful to the subsequent electrochemical refining process because the iron thus introduced into the system is easily transported to the cathode. (TTT)

1766

MELTING AND CASTING OF MAGNOX A-12 ALLOY AND THE PROPERTIES OF ITS EXTRUDED SPECIMENS. Yukiyasu Watanabe, Tsuneyoshi Okamoto, Kazuo Sootome, Katsuhisa Nakajima, and Shigeo Aoki (Nikko Copper Works, Furukawa Denko, Ltd., Japan). J. Atomic Energy Soc. Japan 2, 531-41(1960) Sept. (In Japanese)

A description is given of some of the results of research on the melting and casting of Magnox A-12 alloy as well as on the properties of its extruded specimens. An ingot of 150mmϕ (× 300 to 320mm), weighing about 10 kg, was prepared, and melting and casting were carried out in argon; by this method of melting and casting in argon, ingots containing less slag and pinholes were obtained. When the alloy was melted at high temperatures and cast at low temperatures, large grain size was obtained; but it was not the same as with pure magnesium. Although the segregation of aluminum within the interior of the ingots was extremely small, beryllium segregated onto the surface as well as at the lower part of ingots; and iron was rich near the gate and silicon on the surface. Since beryllium is likely to evaporate from the molten alloy as well as to sink to its bottom, it was necessary to take this into consideration. The ingots had a hardness of ~40 VHN, a tensile strength at room temperature of 12 to 14kg/mm^2, and an elongation of 8 to 12%. The grain size of the specimens at high temperature (about 350°C or over) tended to increase conspicuously with an increase in beryllium content. The effect of beryllium content on the tensile strength at high temperature was insignificant. Differences in the manner of cracking were found when the test temperature exceeded 450 and 250°C. The elongation of the specimens was small below 250°C and irregularities were found in the vicinity of 450°C. From the results of creep tests carried out in carbon dioxide, it is ascertained that specimens generally fractured at the creep elongation of 25% or lower below temperatures of 250°C; but at temperatures above 250°C, creep elongation increased so rapidly that sometimes no break down occurred even when it reached 60%. (auth)

1767

ELECTROLYTIC PRODUCTION OF ZIRCONIUM IN A FUSED SALT VOLTAIC CELL. Meyer L. Freedman (General Electric Co., Cleveland). J. Electrochem. Soc. 107, 934-6(1960) Nov.

Sodium metal was used as a soluble anode in a fused salt voltaic cell for the electrolytic production of refractory materials. A charge of NaCl–KCl was placed in a stainless steel container. After melting the salt, the cathode was lowered to the bottom of the cell and sodium metal added. A small amount of K_2ZrF_6 was then added with additional

portions placed in the container at 30 min intervals during the reaction. At the conclusion of the reaction, the zirconium crystals were separated from adhering salts by boiling first with water and then with dilute HCl. Several modifications of the method were tried in order to obtain the highest yield and best crystals. Although the particle size is similar to that reported for the zirconium produced from electrolysis of molten salt solutions, the dendritic form is more pronounced. (M.C.G.)

1768

SWEDISH INVESTIGATIONS ON UO_2 AS REACTOR FUEL ELEMENT. Roland Kiessling (AB Atomenergi, Stockholm). Nukleonik 2, 198-203(1960) Sept. (In German)

A survey is given of the Swedish investigations on the utilization of UO_2 as a reactor fuel element. The reasons for the selection of UO_2 as fuel element, the production and properties of UO_2 powders, the production of UO_2 sintered bodies, and the characteristics of UO_2 as a fuel element are discussed. (J.S.R.)

1769

APPLICATION OF LARGE COBALT-60 SOURCES TO GAMMA-RADIOGRAPHY OF METALS. Józef Domanus and Bogusław Osuchowski (Electrotechnical Inst., Warsaw). Nukleonika 5, 281-300(1960). (In English)

Radiographic control of metal castings and weldings in Poland was previously limited to 150 mm of steel. X-ray machines and radioisotopic sources were used for this purpose. The increasing number of parts of larger thicknesses that must be radiographically controlled created an urgent need for applying larger radiation sources. For this purpose a Gamma Radiography Machine GRM 750 was procured containing a Co^{60} source with a 715 c activity and a 15 mm diameter. Using this source a series of investigations were made to determine the maximum thickness range in steel which can be examined by means of Co^{60} sources. Exposure charts were made for different film-screen combinations, and optimum FFD were determined for various source sizes. Then comparison was made of exposure times for sources of different activities. The radiographic sensitivity was investigated with the groove- and hole-defectometer and Polish Standards IQI. Results obtained with large sources of Co^{60} were compared with those obtained when using the 31 Mev betatron. Radiological protection measures were considered and comparisons were made for containers, protective barriers, and safe distances for sources of different activities. It was determined that γ radiography of steel with Co^{60} sources above 300 mm of thickness is unjustified both from technical and economical points of view. Sources stronger than 750 c of Co^{60} are not suitable for γ radiography. (auth)

1770

Battelle Memorial Inst., Columbus, Ohio.

REACTOR CORE MATERIALS. Technical Progress Review, Vol. 3, No. 3. R. W. Dayton, E. M. Simons, and R. W. Endebrock. 1960. 64p. $0.55(GPO) (domestic), $0.70(GPO) (foreign).

Fuel and Fertile Materials. A review is made of developments in uranium, α-phase uranium alloys, γ-phase uranium alloys, ϵ-phase uranium alloys, dilute uranium alloys, plutonium, thorium, dispersion fuel materials, refractory fuel and fertile materials, mechanism of corrosion of fuel alloys, and basic studies of irradiation effects in fuel. Moderator Materials. Developments in graphite, beryllium metal, beryllium compounds, and solid hydrides are reported. Nuclear Poisons. Research and development are reported. Cladding and Structural Materials. Research is reported on corrosion, radiation effects in nonfuel materials, selected metallurgical aspects of cladding and structural materials, and selected mechanical properties of cladding and structural materials. Special Fabrication Techniques. Developments are reported in melting, casting, heat-treatment, hot-working, cladding, explosive forming, welding, brazing, and nondestructive testing. (W.L.H.)

Corrosion

1771 ANL-6216

Argonne National Lab., Ill.

REMOVAL OF EBWR FUEL ELEMENT SCALE BY SLURRY HONING. Ira Charak. Sept. 1960. 18p. Contract W-31-109-eng-38. OTS.

The scale deposit on the Experimental Boiling Water Reactor fuel plates can be removed by slurry honing the plates with an abrasive-water mixture. Problems inherent in any production operation of this type are discussed. Areas of continued investigation of the method are suggested. (auth)

1772 HW-48413

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

CORROSION OF ALUMINUM IN HIGH PURITY WATER. R. J. Lobsinger and J. M. Atwood. Feb. 11, 1957. 10p. OTS.

Corrosion rates of the aluminum alloys 1245 and M-388 were determined in demineralized water up to 260°C. (C.J.G.)

1773 HW-59687

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A PROPOSED MECHANISM FOR THE CORROSION OF ALUMINUM IN WATER. R. L. Dillon. Mar. 19, 1959. 14p. Contract AT(45-1)-1350. OTS.

Experimental data indicating the logarithmic corrosion process are presented for alloys of aluminum with iron, nickel, and titanium at 360°C. The alloys were observed to corrode by a rate process of the type $C = k_3 \log (k_4 t + k_5)$. (C.J.G.)

1774 IDO-14531

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CORROSION IN NEUTRALIZED RADIOACTIVE WASTE. N. D. Stolica and G. S. Adams. Sept. 21, 1960. 14p. Contract AT(10-1)-205. OTS.

The corrosion of stainless steel types 304L, 347 Nb stabilized, and carbon steel in neutralized Zr–HF waste and in $Al(NO_3)_3$ waste neutralized with paraformaldehyde was studied to ascertain the suitability of these materials for the construction of waste-storage tanks. The tests were run at 60°C for successive periods of 3 and 6 months. The two stainless steels showed promise as tank construction materials in both cases, but mild steel did not. The corrosion rate of caustic-neutralized $Al(NO_3)_3$–HNO_3 fuel-reprocessing-waste solution on 1020 carbon steel was determined at 60°C. Weight-loss data and visual examination of welded samples exposed to the interface and totally submerged indicated that mild steel is not a satisfactory construction material for cooled storage tanks for this waste. (auth)

1775 ORNL-2924

Oak Ridge National Lab., Tenn.

CORROSION OF MATERIALS BY LITHIUM AT ELEVATED TEMPERATURES (thesis). E. E. Hoffman. Oct. 27, 1960. 150p. Contract W-7405-eng-26. OTS.

Submitted to the Univ. of Tennessee.

An investigation was conducted to determine the corrosion resistance of various materials to lithium at 1000 to 1900°F in static and dynamic systems. Evaluation of test results was based primarily on metallographic examination, weight-change data, dimensional changes, and chemical analyses. The static tests were conducted in constant-temperature systems at 1500 to 1900°F for time periods of 100 to 400 hr. Pure metals, alloys, and ceramics were included in the studies. Good corrosion resistance in static systems was exhibited by Be, Cr, Co, Fe, Re, Ti, and Zr; by Co- and Fe-base alloys; and by the ceramic carbides of Cr, Ti, and Zr. Materials which showed promise in static tests and which were available in the form of tubing or pipe were tested in dynamic systems containing temperature gradients. Lithium flow velocities of 1 to 8 ft/min and temperature differences of 100 to 600°F between hot and cold sections were used. Hot-zone temperatures ranged from 1000 to 1900°F and test periods varied between 100 and 3000 hr. Inconel, stainless steels, and zirconium were the materials studied. Only zirconium was found to be satisfactory at hot-zone temperatures of at least 1500°F. Other results and discussions are included. (auth)

1776 TID-7587

Atomic Energy Commission, Washington, D. C. and European Atomic Energy Society.

AEC-EURATOM-CONFERENCE ON AQUEOUS CORROSION OF REACTOR MATERIALS, BRUSSELS, BELGIUM, OCTOBER 14-17, 1959. July 1960. 468p. OTS.

Abstracts were prepared for 17 of 22 papers presented at the AEC–Euratom Conference on Aqueous Corrosion of Reactor Materials. (C.J.G.)

1777 TID-7587(p.12-29)

Oak Ridge National Lab., Tenn.

CATHODIC PROCESSES IN CORROSION. G. H. Cartledge.

Various kinetic parameters controlling the corrosion process are considered. A kinetic analysis of the anodic dissolution of iron revealed this process to be autocatalytic. Experimental results on cathodic corrosion processes in the reduction of protons, O_2, H_2O_2, UO_2^{++}, and Cu^{++} are presented. Electrode materials included iron, zirconium, and stainless steel. The effect of γ radiation on the electrochemistry of aqueous systems was discussed. (C.J.G.)

1778 TID-7587(p.30-45)

Oak Ridge National Lab., Tenn.

THE ROLE OF CRYSTAL IMPERFECTIONS IN THE CHEMICAL REACTIVITY OF METAL SURFACES. F. W. Young, Jr., J. V. Cathcart, and L. H. Jenkins.

The effect of crystal imperfections on surface reactions of metals is discussed relative to two types of imperfections: point imperfections (vacancies, interstitials, and impurity atoms) and line imperfections (dislocations). The development of etch pits at dislocations is considered. Experiments designed to determine the conditions for etch-pit formation at dislocations are described. The effect of nucleation in the growth of oxide films on metals is considered. Experiments on the effect of neutrons on nucleation in oxide films are described. (C.J.G.)

1779 TID-7587(p.46-7)

École Nationale Supérieure des Mines, Paris. Centre de Recherches Institut Francais du Pétrole des Carbrants et Lubrifiants, Paris and Metallurgiques.

CONDITIONS OF FIXATION OF RADIOACTIVE SULFUR ON THE SURFACE OF IRON SAMPLES AND THE CONSEQUENCES FOR STUDY OF THE CORROSION OF FERROUS ALLOYS. B. Le Boucher, C. Libanati, and P. Lacombe.

A procedure for the fixation of S^{35} on the surface of iron is described. The surface concentration was uniform on each grain, but varied from one crystal to another. The quantity fixed was greatest for the least dense lattice planes. (C.J.G.)

1780 TID-7587(p.48-70)

Argonne National Lab., Ill.

BEHAVIOR OF REACTOR STRUCTURAL MATERIALS FROM THE STANDPOINT OF CORROSION AND CRUD FORMATION. C. R. Breden.

The corrosion rates of various cladding and reactor structural materials are reviewed. Factors affecting corrosion rates and corrosion-product release rates are discussed. Radioactive crud is discussed relative to sources, factors affecting deposition, and effect of pH. (C.J.G.)

1781 TID-7587(p.71-95)

Battelle Memorial Inst., Columbus, Ohio.

CORROSION BEHAVIOR OF CLADDING MATERIALS IN HIGH-TEMPERATURE WATER. W. E. Berry.

The corrosion of zirconium alloy, austenitic stainless steel, and niobium alloy claddings in high-temperature water is reviewed. The causes of stringer formations and factors influencing hydrogen absorption in zirconium alloys are discussed. (C.J.G.)

1782 TID-7587(p.108-15)

Metallgesellschaft A.G., Frankfurt am Main.

HIGH-TEMPERATURE WATER CORROSION OF ZIRCONIUM AS INFLUENCED BY PALLADIUM ADDITIONS. H. W. Schleicher.

Corrosion rates of alloys of zirconium containing 0.1 to 0.2 wt. % palladium were determined in steam at 400 and 480°C under 200 atm. pressure. The additions of palladium increased the corrosion resistance of zirconium. Possible mechanisms responsible for this increase are discussed. (C.J.G.)

1783 TID-7587(p.116-20)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AN INVESTIGATION OF THE MECHANISM OF OXIDE FILM GROWTH AND FAILURE ON ZIRCONIUM AND ZIRCALOY-2. B. Cox.

Mechanisms of oxide film growth and failure on zirconium and Zircaloy-2 are discussed. Oxide film growth was found to be described by the sum of two logarithmic rate laws, the first pertaining to the growth of the uniform interference color oxide and the second being a measure of the amount of oxidant transported via easy diffusion paths in the oxide. (C.J.G.)

1784 TID-7587(p.121-33)

General Electric Co. Research Lab., Schenectady, N. Y.

CONCERNING THE MECHANISM OF ALUMINUM CORROSION IN HIGH TEMPERATURE WATER. W. E. Tragert.

The chemical composition and crystalline structure of the hydrous oxide films formed on aluminum in water was studied as a function of temperature, pressure, and exposure time. Surface oxide phase relationships and growth kinetics were discussed. (C.J.G.)

1785 TID-7587(p.134-52)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DISSOLUTION OF ALUMINUM OXIDE AS A REGULATING FACTOR IN AQUEOUS ALUMINUM CORROSION. R. L. Dillon.

The solubility of aluminum corrosion product in contact with metallic aluminum in deionized water was determined at 80 to 350°C. Evidence is presented to show that oxide dissolution results in the formation of a porous oxide on aluminum exposed in refreshed dynamic systems. Dynamic corrosion-rate data were analyzed on the basis of parabolic film growth and a linear oxide degradation process acting simultaneously on the system. The degradation process was shown to be a function of refreshment rate. (auth)

1786 TID-7587(p.153-64)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE CORROSION OF ALUMINUM, ITS ALLOYS AND SAP IN HIGH PRESSURE STEAM. J. N. Wanklyn and N. J. M. Wilkins.

The corrosion of aluminum and aluminum alloys in steam at 325°C was studied. The results are discussed in terms of uniform corrosion and rapid penetrating attack. (C.J.G.)

1787 TID-7587(p.165-87)

Argonne National Lab., Ill.

AQUEOUS CORROSION OF 1100 ALUMINUM AND OF ALUMINUM–NICKEL ALLOYS. J. E. Draley.

The corrosion of 1100 aluminum in water at 50 and 70°C was found to take the form of microscopic pits. Corrosion studies were performed on 1100 aluminum in helium- and oxygen-saturated water at 50 and 70°C. The effects of pH and dissolved salts on the above studies were determined. The effects of dissolved salts and silicon content of the alloy on the corrosion properties of Al–Ni alloys in water at 350°C were investigated. (C.J.G.)

1788 TID-7587(p.236-96)

Brussels. Centre d'Étude de l'Énergie Nucléaire.

STUDY OF CORROSION IN HEAT EXCHANGERS OF BR-2. L. Valette.

Studies were performed on the corrosion of aluminum, stainless steel, and chromium steel by the chlorine ion at 47°C relative to their use as structural materials in the heat exchangers of the Belgian Reactor-2. (C.J.G.)

1789 TID-7587(p.297-306)

General Electric Co. Research Lab., Schenectady, N. Y.

FACTORS IN THE STRESS CORROSION CRACKING OF REACTOR MATERIALS. W. E. Tragert.

Experimental data and hypotheses concerning the mechanisms of stress-corrosion failure of reactor structural metals are reviewed. (C.J.G.)

1790 TID-7587(p.307-89)

Los Alamos Scientific Lab., N. Mex.

AQUEOUS CORROSION OF URANIUM AND ITS ALLOYS. James T. Waber.

Experimental data and theories pertaining to the aqueous corrosion of uranium metal and various γ-phase alloys are reviewed. A "hydroxide mechanism" which incorporates some of the features of both the hydride and oxide mechanisms is suggested. Chemical and physical properties and crystal phases of UH_3 and UO_2 are reviewed. (auth)

1791 TID-7587(p.390-404)

Argonne National Lab. Ill.

HIGH TEMPERATURE AQUEOUS CORROSION OF URANIUM ALLOYS CONTAINING MINOR AMOUNTS OF ALLOYING ELEMENTS. J. E. Draley.

The corrosion resistance of U–Zr, Nb–U–Zr, Nb–U, Nb–Sn–U, Si–U, and Al–Ni–U alloys in high-temperature water was investigated. (C.J.G.)

1792 TID-7587(p.405-33)

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

AQUEOUS CORROSION OF ALUMINUM–NICKEL–URANIUM BONDS. C. L. Angerman and E. C. Hoxie.

The quality of the bond between aluminum cladding and nickel-plated uranium cores was determined by the "pinhole" type of corrosion test in deionized water at 95 to 98°C. Regardless of bond quality, the bond zone was composed of the intermetallic compounds Al_3Ni, Al_3Ni_2, U_6Ni, and UNi_5. The corrosion resistance of the bond layer was found to be dependent upon the distribution of oxide impurities in the bond layer, the corrosion layer being good when the oxide phase was dispersed and poor when the oxide existed as a continuous layer. (C.J.G.)

1793 TID-7587(p.434-6)

Comprimo N. V., Amsterdam and Babcock & Wilcox Co., New York.

THE CORROSION OF THE FUEL PLATES IN THE NETHERLANDS A 57 REACTOR. Jan P. Nikkessen and Edmond J. Silk.

Corrosion of fuel plates in the Netherlands 57A Reactor was directly attributed to flux entrapment and the subsequent leaching of this residual flux through imperfections in the brazed joint. (C.J.G.)

1794 HW-tr-18

CONTRIBUTION TO THE STUDY OF THE CORROSION OF ZIRCONIUM AND ZIRCALOY-2 IN SUPERHEATED STEAM AT 400°C (105 kg/cm^2). H. Coriou. Translated by Liz Appleby from Mém. sci. rev. mét. 57, 511-19(1960). 21p, JCL. Originally issued in French as CEA-1387.

ROTATING AT HIGH SPEED, PARTIALLY IMMERSED IN THE SOLUTION TO BE EXAMINED and PART 5. ARCS

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 21928.

1795

EMBRITTLEMENT OF STEEL BY HYDROGEN DURING CLEANING AND ELECTROLYTIC PLATING. Uno Trägårdh (Kungliga Tekniska Högskolan, Stockholm). Corrosion et anti-corrosion 8, 177-84(1960) May. (In French)

Methods are described for measuring the brittleness and H_2 content of steels. Embrittlement during cleaning was studied under condition of acid or alkaline bath, cathodic and anodic, with and without inhibitors. Experiments were also run to determine the brittleness of samples of steel after electrolytic plating with different metals, such as Zn, Cd, Cu, Ag, Ni, Cr, Sn, and Sn alloys. Solution compositions and additives were varied. The restoration to ductility after long periods of time was also studied. (tr-auth)

1796

FACTORS INVOLVED IN STRESS CORROSION OF MATERIALS USED IN REACTORS. W. E. Tragert (General Electric Research Lab., Schenectady, N. Y.). Corrosion et anti-corrosion 8, 196-201(1960) May. (In French)

An attempt is made to explain the formation of cracks by stress corrosion in metals and alloys in the light of a number of hypotheses. The hypotheses may be classified as electrochemical, electrochemical-mechanical, and strain absorption. In the case of uranium, the contributions of the theories in explaining the observed phenomena are discussed. (T.R.H.)

1797

APPLICATIONS OF RADIOISOTOPES IN PROBLEMS OF METALLIC CORROSION. P. Lacombe (École des Mines, Paris). Corrosion et anti-corrosion 8, 215-30(1960) June.

The selectivity and sensitivity of radioactive methods considerably enlarge the field of study of corrosion problems. The principle applications are study of impurity segregation in grain boundaries, role of intergranular corrosion, composition heterogeneities in alloys, and surface states of metals modified by adsorption of certain elements such as sulfur. The mechanism of action of corrosion inhibitors can also be determined quantitatively. Finally the kinetics of dissolution of metals can be studied in its early stages because of the sensitivity of counting methods. Some examples of applications are cited, principally in the ferrous metals. (tr-auth)

1798

RECENT STAINLESS STEELS. M. L. Guitton (Société Ugine-Gueugnon, [Paris]). Corrosion et anti-corrosion 8, 261-81(1960) July-Aug. (In French)

After a brief review of the very rapid development of stainless steels, a study is presented of 17%-chromium steels and 18-10 steels. For each the characteristics, structures, principle treatments, and corrosion resistance are given. Descriptions are given of cladding, welding, polishing, finishing, and the many applications of these steels. (T.R.H.)

1799

CORROSION RESISTANCE OF TITANIUM ALLOYS. V. V. Zholobov and A. S. Kudukis. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 77-80(1960) July-Aug. (In Russian)

The high corrosion resistance of titanium is attributed to the presence of a protective oxide layer on the surface of the pure metal or its alloys. Tests indicate that titanium alloys have a low corrosion resistance in sulfuric and hydrochloric acids, moderate resistance in phosphoric acid, and strong resistance against attack by acetic acid. However, it was found that certain alloys containing additions of molybdenum or silicon have good resistance against corrosion by very aggressive media, such as boiling sulfuric acid. In addition to Soviet alloys, two American titanium alloys were included in the study. (TTT)

1800

CORROSION OF STEELS IN LIQUID BISMUTH AND LEAD. J. A. James and J. Trotman (Associated Electrical Industries, Ltd., Rugby, Eng.). J. Iron Steel Inst. (London) 194, 319-23(1960) Mar.

The corrosion of a variety of steels in liquid lead and bismuth was studied in the temperature range 600 to 900°C by measuring weight losses of steel pins after immersion in the hot side of a thermal convection loop. In uninhibited bismuth, low-alloy steels are more resistant to corrosion than 13% Cr–Fe or 18-8 stainless steel. Both nickel and manganese have an equally deleterious effect on the corrosion resistance of 2¼% Cr–1% Mo steel. In bismuth inhibited with zirconium the best steels tested had extrapolated corrosion rates less than 0.005 in./year at 700°C with a 50°C temperature differential. The corrosion of steels in uninhibited lead is about 40 times less than in uninhibited bismuth under similar conditions, and the corrosion is reduced by addition of 500 ppm titanium, with the same order of steel resistance as for the inhibited bismuth test. (auth)

1801

ON THE PROBLEM OF CORROSION RESISTANCE OF STAINLESS STEEL. II. INFLUENCE OF THE HEAT TREATMENT UPON THE RESISTANCE TO INTERCRYSTALLINE CORROSION. Irina Cornea and Ştefan Zămîrcă. Rev. roumaine mét. Acad. rép. populaire Roumaine 4, 47-52(1959). (In English)

The effect of heat-treatment and of the ferrite content on the susceptibility of stainless steel to intercrystalline corrosion was studied. The steel investigated contained 0.12% C, 0.8% Mn, 1.15% Si, 20.11% Cr, 9.77% Ni, and 0.27% Ti. The test sheets, after being rolled to 0.95 mm thickness, pickled, and heat-treated, were held at 650°C for 30 min, 3 hr, and 8 hr. The susceptibility to corrosion was then shown by boiling the sheet in a sulfur-copper solution for 72 hr. Sound and bending tests were used to determine the extent of the corrosion. The results of these tests are tabulated and show that the intercrystalline corrosion increases when the quenching temperature and the aging at this temperature are increased. The presence of ferrite in austenitic steels reduces their corrosion susceptibility. (J.S.R.)

1802

EMBRITTLEMENT BY LIQUID METALS. W. Rostoker, J. M. McCaughey, and H. Markus. New York, Reinhold Publishing Corporation, 1960. 169p. $7.95.

Published data on embrittlement by liquid metals are collected, reviewed, and evaluated. In addition, unpublished results of the latest research in this field are given. The seven chapters cover literature reviews, occurrence of liquid-metal embrittlement, crack propagation, factors influencing embrittlement, delayed failure, theory of metal fracture, and mechanism of liquid-metal embrittlement, respectively. (D.L.C.)

Fabrication

1803 AD-235279

Ladish Co., Cudahy, Wis.

BERYLLIUM FORGING PROGRAM. PHASE II. Interim Engineering Report No. 3 [for] February 9, 1959 to February 29, 1960. A. F. Hayes. 43p. Contract AF33(600)-36795.

The effects of temperature on the forgeability and tensile properties of beryllium were studied. Beryllium samples were encased in steel and upset forged at 1300, 1375, 1450, 1550, 1750, and 1900°F. The most desirable forging temperature was found to be 1375°F. A preferred orientation study of a sample forged at 1375°F showed basal plane alignment in planes parallel to the forging face to be six to eight times that of random orientation. A combination x ray, ultrasonic, and dye penetrant inspection technique for beryllium flaws is also described. (J.R.D.)

1804 BAW-1061

Babcock and Wilcox Co. Research Center, Alliance, Ohio.

LIQUID METAL FUEL REACTOR EXPERIMENT. Progress Report No. 1 on INDUCTION WELDING. D. E. Dean. Oct. 1959. Changed from OFFICIAL USE ONLY July 1, 1960. 53p. Contract AT(30-1)-1940. OTS.

High-frequency induction heating equipment is being used to investigate the feasibility of induction welding for remote application. Of the 100 or more pressure-forged butt welds made, only a few possessed the mechanical strength and ductility required for satisfactory root and face bends. In most cases the single-turn inductors used could not provide uniform 360° heating of the joint. Continuation of the investigation is recommended since the development of a method to provide uniform heating could lead to the production of consistently sound butt welds. (auth)

1805 CEND-86

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

A PROGRAM TO STUDY THE FEASIBILITY OF AND DEVELOP AN APPARATUS FOR THE ULTRASONIC ROLL BONDING OF FUEL PLATES. Quarterly Progress Report for January 1, 1960–March 31, 1960. Joseph Kozol. Changed from OFFICIAL USE ONLY Aug. 15, 1960. 56p.

Contracts AT(30-1)-2379 and CEND 5059-3. (NYO-9017). OTS.

Activities at Combustion Engineering, Inc., Nuclear Division, and Aeroprojects, Inc., are reported. Weldability studies on aluminum and stainless steel materials of interest are reported. A nonetching alkaline wash followed by a chromate rinse was most conducive to bonding and was a good clad surface finish after bonding. The contoured edge-rail technique of ultrasonic edge bonding appears promising although it requires precise control of the clearance between the core holding fixture and edge rail. Ultrasonic bonding equipment capable of increased power, welding speeds, and clamping forces is being developed. Work was initiated on production of dispersion cores and miniature roll-bonded specimens. Test methods for evaluating the quality of ultrasonically bonded prototype fuel-element specimens were established and a list of these methods is included along with results of tests. (J.R.D.)

1806 HW-OREMET-1
Oregon Metallurgical Corp., Albany.
SPECIALIZED CASTING AND FORMING OF REACTIVE METAL SHAPES. [Period covered]: May 15, 1959–March 31, 1960. Thomas A. Hamm. Mar. 31, 1960. 20p. For General Electric Co. [Hanford Atomic Products Operation]. Contract W-31-109-Eng-52, Subcontract DDR-61-1. OTS.

Forged rolled sheet and rod material were produced from 2 at. % Sn–2 at. % Nb–Zr alloy. Techniques and procedures for producing this material are described. It is concluded that the alloy is forgeable in machined forging billet size of four inches. (C.J.G.)

1807 HW-OREMET-3
Oregon Metallurgical Corp., Albany.
SPECIALIZED CASTING AND FORMING OF REACTIVE METAL SHAPES. [Period Covered]: May 15, 1959–December 30, 1959. Thomas A. Hamm. Dec. 30, 1959. 15p. For General Electric Co. [Hanford Atomic Products Operation]. Contract W-31-109-Eng-52, Subcontract DDR-61-3. OTS.

Techniques for arc casting, machining, and fabricating large uranium plugs encased in stainless steel were developed. (C.J.G.)

1808 HW-OREMET-4
Oregon Metallurgical Corp., Albany.
SPECIALIZED CASTING AND FORMING OF REACTIVE METAL SHAPES. [Period covered]: October 19, 1959–April 30, 1960. Thomas A. Hamm. 10p. For General Electric Co. [Hanford Atomic Products Operation]. Contract W-31-109-Eng-52, Subcontract DDR-61-4. OTS.

Techniques and procedures were developed for casting reactor grade Zircaloy-2 to specified shapes. (C.J.G.)

1809 NMI-7230
Nuclear Metals, Inc., Concord, Mass.
POWER REACTOR PROGRAM. Progress Report to E. I. du Pont de Nemours and Company for the Period July 1, 1960 through July 31, 1960. S. Isserow, A. M. White, H. F. Sawyer, A. D. Donaldson, W. L. Larson, W. J. Richmond, P. R. Smoot, H. M. Green, and W. B. Tuffin. Sept. 7, 1960. 32p. Contract AT(30-1)-1565. Sponsor Agreement No. S-31. OTS.

Several improvements were made in the design of billets for thin-walled tubes of unalloyed uranium. Of three experimental billet designs for thin-walled inner tubes, two yielded tubes with very little clad thinning; one of these designs is being used for three more prototype tubes. On the basis of data previously developed by extrusion of prototype tubes, two tubes with enriched U–1.5 wt. % Mo cores were extruded for the Vallecitos Boiling Water Reactor (VBWR). Eleven unalloyed uranium specimens for the Savannah River Laboratory capsule-irradiation program were prepared and shipped. Additional creep and stress-rupture data for U–1.5 wt. % Mo alloy and unalloyed uranium were obtained. Efforts on the program to develop stainless-steel–Zircaloy joints were directed toward careful study of joints already produced, primarily to elucidate the mechanism by which the interfaces at the ends of the tapers sometimes are not bonded. (For preceding period see NMI-7229.) (W.L.H.)

1810 NP-9312
Brush Beryllium Co., Cleveland.
FUSION WELDING OF BERYLLIUM. Progress Report No. 3 [Covering Period] November 1, 1959–January 31, 1960. Technical Report No. 167. B. M. MacPherson and W. W. Beaver. Feb. 1960. 22p. Project No. 7351. Contract AF33(616)-6413.

The effects of coating drawn beryllium wire with Cu, Ag, Au, Ni, Fe, Co, Sn, Cr, Zn, and Cd on the fusion weld properties of beryllium are reported. Since a post-heat treatment of beryllium fusion welds is beneficial to the physical properties, initial evaluations of various heat treatments have been made. Metallurgical studies on $\frac{1}{8}$- and $\frac{1}{4}$-in.-thick QMV beryllium welded sheets are in process for butt and fillet-welded "T" joints. The welding of $\frac{1}{4}$-in.-thick Be sheets served as an excellent medium for examining the function of fixture materials on the weldability of this metal. With the successful welding of $\frac{1}{4}$-in.-thick beryllium in one pass, initial work on making multiple-pass fusion welds in thicker sections of beryllium was performed. (For preceding period see NP-8626.) (auth)

1811 NP-9353
Spain. Junta de Energiá Nuclear, Madrid.
A DISPERSION TYPE FUEL ELEMENT FOR LOW POWER RESEARCH REACTORS. J. Redondo, H. Bergua, and J. Terraza. Oct. 1959. 5p.

Symposium on Nuclear Materials held at Saltsjöbaden, Sweden, October 5-9, 1959.

A fabrication procedure is given for a dispersion-type fuel element. The core is a cermet of U_3O_8 and aluminum powder containing 20% enriched uranium. An aluminum alloy is used for the cladding material. (C.J.G.)

1812 TID-6569
Gladding, McBean and Co., Los Angeles.
DEVELOPMENT OF FLAT PLATE CERAMIC FUEL ELEMENTS. Technical Progress Letter No. 14 for Summary of work done from January 1, 1959 to February 28, 1960. [Jarvis J. Fargo]. Mar. 23, 1960. 16p. Contract AT(04-3)-249. OTS.

The development of a process to fabricate flat ceramic plates of urania by use of a rolling method to form the raw powder and binder into sheets is reported. The process used for rolling Ceramic Veneer was successfully modified to produce thin sheets of urania, rolled 4.25 in. wide, 24 in. long, and 0.040 to 0.084 in. in thickness. Pieces of the rolled strip were fired in hydrogen to give sintered sheets as large as 1.5 in. wide by 6.5 in. long, with densities up to 95% of theoretical. A study of organic temporary binders suggested that cellulose in toluene plus an addition of camphor was best able to yield a strong, continuous sheet of rolled material that had good density and fired well. Firing in dry hydrogen at 3050°F on molybdenum sheets gave best results. Six commercially available types of urania powder were evaluated for their suitability as raw materials for forming by the rolling process. (W.L.H.)

1813 WADC-TN-59-394

New York. State Univ. Coll. of Ceramics, Alfred. THE HOT PRESSING OF FINE GRAINED CERAMIC OXIDES FOR USE IN THERMAL CONDUCTIVITY STUDIES. Period covered: November 1, 1958 to October 31, 1959. R. K. Francis, J. J. Swica, R. S. Truesdale, and J. R. Tinklepaugh. Nov. 16, 1959. 32p. Project No. 7022. Contract AF33(616)-3798. (AD-236724).

The relations between time, temperature, pressure, and grain growth in hot pressing were studied using alumina grain to determine the techniques necessary for the production of dense polycrystalline alumina having a grain size in 4- to 5-μ range. It was found that alumina having a density of the order of 95% of theoretical and grain size in the desired range could be produced using a short time at maximum temperature in hot pressing. (auth)

1814

WELDING AND BRAZING TWO COLUMBIUM ALLOYS. C. F. Burrows, M. M. Schwartz, and L. J. Gagola (Baltimore Div., Martin Co.). Materials in Design Eng. 52, No. 4. 13-15(1960) Oct.

Niobium alloys were successfully joined by fusion and resistance welding and brazing. The two alloys used were Fansteel 82 (Ta-Zr-Nb) and Dupont D31 (Ti-Mo-Nb). Problems in the welding of these materials and the methods used are discussed. Fusion welding was done in an inert atmosphere. Dried argon, helium, and mixtures of the two were used in the chamber and in the torch. In resistance welding, Fansteel 82 foil was shaped and welded into honeycomb cores for brazing into sandwiches. Core nodes were welded with stainless steel equipment using a 100 kv power source. Five brazing alloys were tested and titanium appeared to give the best results. (M.C.G.)

1815

THE FABRICATION OF BORON BY POWDER METALLURGICAL TECHNIQUES. P. Best and S. R. Twigg (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Metallurgia 62, 146-52(1960) Oct.

An investigation into the fabrication of boron into shapes, with a view to its use in nuclear reactors as control rods showed that boron-rich alloys containing about 10 wt. % of such metals as nickel, copper, and manganese can be fabricated by a simple hot pressing technique. The bulk density of the compacts is suitable for certain types of nuclear reactor. (auth)

1816

BRAZING FUEL ELEMENTS FOR THE OMR. N. W. D. Chrimes (Hawker Siddeley Nuclear Power Co., Ltd., [London]). Nuclear Power 5, No. 54, 97-8(1960) Oct.

The problem in fabricating fuel elements for organic-moderated reactors by filling stainless-steel tubes (0.5 in. ID × 0.0068 in. thick) with enriched UO_2 pellets and combining a number of these tubes (usually 19) into a bundle inside an outer coolant tube is joining the tubes together with spacer pieces to form a rigid bundle while keeping the amount of steel to a minimum. Spot welding was rejected, and furnace brazing was chosen, with palladium-base brazing alloys. Some of the properties of brazed joints with these alloys are given. A complete experimental fuel element was brazed with 0.020-in.-dia. wire of PN1 alloy in a hydrogen atmosphere, and the joints were judged to be satisfactory. Suggestions are offered for improving the brazing. Some of the problems introduced by brazing in this way are decrease of strength properties of steel, disortion, and need of a nondestructive testing method to check for fuel-element tube perforation and weakening. (D.L.C.)

1817

WEAR MEASUREMENTS IN DRAWING OF ROD STEEL WITH RADIOACTIVE DIES. Werner Lueg and Paul Funke, Jr. (Max-Planck-Institut für Eisenforschung, Düsseldorf). Stahl u. Eisen 79, 996-1002(1959) July 9. (In German)

The procedure for determining the wear of a radioactive die by chemical isolation of the dust and intensity measurement was tested in the drawing of rod steel. In industrial and laboratory experiments, the effects of different surface treatments and lubricants on wear of the drawing die can be studied. The results show that for radiated unlimed raw materials, the greatest wear for all lubricants occurs; and that dried drawing soaps as lubricants for the draw-hole protect the best. (tr-auth)

1818

HOW TO MACHINE ZIRCONIUM ALLOYS. A. O. Schmidt and J. R. Roubik (Kearney & Trecker Corp., Milwaukee). Tool Engr. 43, No. 5, 87-9(1959) Nov.

Tests showed that Zircaloy 2 can be machined with tools recommended for machining high-strength aluminum alloys. The fire hazard is reduced by large relief angles (~ 10°) which prevent the material from building up on the flanks of the tool, positive rake angles which reduce the amount of heat in thin workpieces, and emulsions which also prevent clinging of chips to the tools and thus improve the surface finish in milling. Since smeared metal residues left by metal-cutting processes are undesirable, tools must be designed to stay sharp and cut clean. Because of these requirements, a tool for machining Zircaloy must have positive axial rake angles, especially for milling a pocket, and thus herringbone slab mills are necessary. However, it does not matter whether the primary rake angle is $-10°$ or $+10°$, so long as the relief angle is ~ 10° The net power requirements for sharp cutters in milling Zircaloy-2 were determined in comparison to cold-rolled steel and aluminum. It was found that the C-2 type carbide showed more of a tendency toward peripheral interference and wear than the C-50 type. (D.L.C.)

1819

WELDING OF NICKEL–CHROMIUM–IRON ALLOY FOR NUCLEAR-POWER STATIONS. C. E. Witherell (International Nickel Co., Inc., Bayonne, N. J.). Welding J. (N.Y.) 39, 473s-8s(1960) Nov.

The resistance of the 15% chromium, 7% iron, nickel alloy to stress-corrosion cracking stimulated the nuclear-power field to consider extensive use of this alloy for components of nuclear-power stations. The fabrication for this service demands an exceptionally high level of weld integrity, and added to this is the necessity for joining and overlaying unusually thick sections. The shortcomings of existing welding products in meeting the rigid standards set for these applications required the development of a completely new nickel-chromium-iron alloy welding electrode and inert-gas filler wire specifically engineered for nuclear-power-plant fabrication. The covered electrode, designated as MIL Type 4N85, produced crack-free and porosity-free welds in all positions, even under severely restrained conditions. The increased tolerance of the weld metal for dilution by iron makes this electrode particularly well suited for welding nickel-chromium-iron alloy to carbon or stainless steel and for overlaying steel. The filler wire designated as MIL Type EN87/RN87, intended for welding by the inert-gas-shielded processes, produced nickel-chromium-iron alloy welds and overlays to the same quality level as the 4N85 covered electrode. The welds deposited by these new materials had good mechanical prop-

erties and were not adversely affected by normal stress-relieving heat treatments used for steels. (auth)

1820

FABRICATION PRINCIPLES FOR WELDED INCONEL X STRUCTURES. H. P. Schane and E. E. Weismantel (Space Atomics Div., Budd Co., Philadelphia). Welding J. (N.Y.) 39, 479-s-83-s(1960) Nov.

The designing of structures of most nickel-base precipitation hardening alloys is critical for service applications in the low-ductility range of 1150 to 1350°F, which also corresponds to the aging temperature. The manufacturing techniques that affect the design and serviceability of critical units are described. Various joint designs and the effect of these designs on weld-joint efficiency are discussed. Weld-cleaning requirements and the effect of improper cleaning on weld quality are stressed. Special welder-qualifying procedures are outlined to determine the ability of producing consistent high-quality welds for service at elevated temperatures. The necessity for post-welding stress relief and final heat treatment is discussed as these operations affect the serviceability of the unit. (auth)

Properties and Structure

1821 AD-235831

Michigan. Univ., Ann Arbor. Willow Run Labs.

THE PHASE DIAGRAM FOR THE BINARY SYSTEM CADMIUM–TELLURIUM. [Report No.] 2900-139-R. Donald R. Mason and Bernard M. Kulwicki. April 1960. 34p. Project MICHIGAN. Contract DA-36-039 SC-78801.

The phase diagram for the Cd–Te system was determined using differential thermal analysis. Thermodynamic analysis showed that the system CdTe–Te appeared to form an ideal solution. The latent heat of fusion of CdTe is estimated to be 10,700 cal/gram molecule. It was found that the system Cd–CdTe is an elementary solution and has a relatively large excess partial molar entropy of solution and a large partial molar enthalpy of solution. These partial molar qualities were independent functions of composition, but not of temperature. The eutectic compositions were determined as 10^{-6} atom-fraction tellurium and about 0.99 atom-fraction tellurium. (auth)

1822 AECU-4639

[Knolls Atomic Power Lab., Schenectady, N. Y.]

APPLICATIONS FOR LANTHANON OXIDES AND OTHER COMPOUNDS IN THE CERAMIC INDUSTRY. G. L. Ploetz and A. T. Muccigrosso. [Jan. 28, 1960]. 14p. OTS.

Separation processes for production of pure rare earth oxides in useful quantities are discussed. A review of applications of these oxides in the ceramic industry in production of glasses, glazes, porcelain enamels, refractories, abrasives, electronic ceramics, and nuclear ceramics is also presented. 46 references. (J.R.D.)

1823 ARF-6046-2

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

SYNTHESIS OF REFRACTORY MIXED OXIDE WITH PEROVSKITE STRUCTURE. Bi-monthly Report No. 2 for the Period July 24, 1960 to September 24, 1960. Y. Harada and S. W. Bradstreet. 11p.

Experimental work on the preparation and measurement of $BaThO_3$ shows that the compound exists and is the most stable compound in the Ba–Th–O system. It is cubic at ordinary temperature, with the perovskite structure, and has a crystal density of 4.59 g/cc. The compound may be prepared from a coprecipitated mixture of the barium and thorium oxalates at 750°C, and the reaction is driven to completion below 1000°C in the presence of an excess of barium. $BaThO_3$ appears to hydrolyze readily in the presence of moisture and/or CO_2. It does not, therefore, appear to have the chemical stability required in a protective coating, and it is inadvisable to measure other coating parameters at this time. It may, however, serve as a superior thermionic emitter. (auth)

1824 CEND-98

Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.

THE DEVELOPMENT AND TESTING OF HOMOGENEOUS CERAMIC FUELS. Progress Report for Period June 1–August 31, 1960. 31p. Contract AT(30-1)-2379. (NYO-2992). OTS.

Activities directed toward establishment of the composition limits for single-phase face-centered cubic structures in the $UO_2–ZrO_2–CaO$ and $UO_2–CeO_2$ systems are reported. Results of efforts to determine the physical, chemical, corrosion, and thermal properties of selected single-phase cubic structures in the two ceramic fuel systems are also included. (J.R.D.)

1825 DMIC-Memo-66

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

PHYSICAL AND MECHANICAL PROPERTIES OF THE COBALT–CHROMIUM–TUNGSTEN ALLOY WI-52. F. R. Morral and H. J. Wagner. Sept. 22, 1960. 23p. OTS. (PB-161216).

The application, fabrication, oxidation resistance, and physical and mechanical properties of the Cr–Co–W alloy WI-52 are reviewed. (C.J.G.)

1826 DP-463

Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.

THERMAL CONDUCTIVITY OF ALUMINUM–LITHIUM ALLOYS CONTAINING UP TO 8% LITHIUM. Louis P. Costas. Apr. 1960. Decl. Aug. 4, 1960. 6p. Contract AT(07-2)-1. OTS.

The thermal conductivities of Al–Li alloys containing up to 8 wt. % lithium were determined at 125 to 260°C. The addition of lithium to aluminum sharply reduces the conductivity from 0.60 cal/(sec)(°C)(cm) for pure aluminum to 0.22 cal/(sec)(°C)(cm) for 2 wt. % alloys; further addition linearly and more gradually decreases the conductivity to 0.16 cal/(sec)(°C)(cm) for a 7.9 wt. % alloy. (auth)

1827 NP-9255

Franklin Inst. Labs. for Research and Development, Philadelphia.

DEVELOP HIGH PURITY BERYLLIUM AND DETERMINE THE MECHANICAL PROPERTIES OF MATERIAL PRODUCED. Bi-Monthly Progress Report [for period] September 1–October 31, 1959. Marvin Herman and Grant E. Spangler. 3p. Contract NOas-59-6242-c. (P-A2323-2).

The deformation and fracture characteristics of beryllium are reviewed. A technique was designed for fabricating electrolytic flake beryllium into rods. (C.J.G.)

1828 NP-9352

Spain. Junta de Energía Nuclear, Madrid.

THE INFLUENCE OF LUBRICATING AGENTS ON THE SINTERING OF UO_2. F. Carrasco, H. Bergua, E. Aparicio, and J. Terraza. Oct. 1959. 11p. Symposium on Nuclear Materials held at Saltsjöbaden, Sweden, October 5-9, 1959.

Data on the influence of a wide variety of lubricants on the low-temperature sintering of UO_2 are reviewed.

Methods for the elimination of the lubricants and their influence on the sinterability of UO_2 are discussed. (C.J.G.)

1829 OOR-2049.2

California. Univ., Riverside.

STUDIES OF PLASTICALLY DEFORMED METALS BY SMALL-ANGLE X-RAY SCATTERING. Technical Report No. 2 [for] March 1959–August 1960. Walter T. Ogier, Robert L. Wild, L. M. Richards, and J. C. Nickel. 24p. Contract DA-04-495-ORD-1243.

Experimentation revealed that observation of small-angle double Bragg scattering rise is a satisfactory tool for the study of cold work in metals and for the study of recrystallization in face-centered cubic structures such as nickel. Observations conform to accepted ideas concerning the mosaic substructures of crystals. Since the diffuse scattering is calculated statistically, the method is limited to observation of extended areas in polycrystalline metals. The method is thus ideally suited to the use of focusing small-angle scattering systems. (auth)

1830 TID-6651

Franklin Inst. Labs. for Research and Development, Philadelphia.

STUDY OF X-RAY EFFECTS CAUSED BY POINT DEFECTS IN METALS. Interim Report [for] June 1 to August 31, 1960. F. R. L. Schoning. 5p. Contract AT(30-1)-2585. (I-A2431-1). OTS.

Phase changes occurring during the electrolytic charging of palladium single crystals with hydrogen were investigated. Charging times were from 3 to 261 hr; the only difference in patterns was that the α-phase reflections became successively weaker with charging until only the β phase was observed. No change of lattice parameter in the crystal was observed after 261 hr of charging. Lattice parameter changes were observed in a palladium polycrystalline wire in both phases after short periods of charging. (C.J.G.)

1831 TID-6757

Los Alamos Scientific Lab., N. Mex.

CRYSTALLOGRAPHIC DATA FOR NIOBIUM MONOCARBIDE. E. K. Storms, N. H. Krikorian, and C. P. Kempter. [1960]. 3p. OTS.

X-ray-diffraction studies were performed on $NbC_{0.993}$. The lattice constant was determined to be 4.47095A. (C.J.G.)

1832 UCRL-6132

California. Univ., Livermore. Lawrence Radiation Lab.

THERMAL EXPANSION OF HIGH TEMPERATURE MATERIALS. Oscar H. Krikorian. Sept. 6, 1960. 7p. Contract W-7405-eng-48. OTS.

Thermal expansion data for high-temperature materials (melting above 1000°C) are reviewed in terms of per cent linear expansion above 25°C. (C.J.G.)

1833 WADC-TN-59-215

Battelle Memorial Inst., Columbus, Ohio.

THERMAL PROPERTIES OF MATERIALS AT ELEVATED TEMPERATURES. Period covered: July 1, 1958 through June 30, 1959. Herbert W. Deem, Webster D. Wood, and Charles F. Lucks. Aug. 1959. 22p. Project No. 7360. Contract AF33(616)-5849. (PB-161478). OTS.

Apparatuses were designed and assembled for making linear-thermal-expansion, specific-heat, and thermal-conductivity measurements to 5000°F or above on metals and ceramic-type materials. Linear-thermal-expansion and specific-heat measurements are made in the same apparatus using the same specimen. Expansion measurements are made by directly viewing fiducial marks on a cylindrical specimen with two telemicroscopes. Specific-heat measurements are made by measuring the heat input to an inner heater that is required to heat the specimen of a known mass over a measured temperature range. Thermal-conductivity measurements are made by a radical heat-flow method using a thick-walled-cylindrical specimen with an encircling graphite heater. The apparatuses are essentially completed and are ready for calibration. No measurements are reported. (auth)

1834 WADC-TR-58-653

National Bureau of Standards, Washington, D. C.

A STUDY OF 17-7 PH STAINLESS STEEL. Period covered: January 1957 to December 1958. Nesbit L. Carwile and Samuel J. Rosenberg. Feb. 1959. 42p. Project 7351. Contract AF33(616)-57-7. (AD-216533; PB-161089). OTS.

The effects of different heat-treatments on mechanical properties and microstructures of 17-7 PH stainless steel were studied. The best tensile and stress-rupture properties at 600 and 800°F were obtained with the TH 950 treatment. Long exposure at 800°F, either with or without stress, produced embrittlement. It was found that original properties may be approximately restored by re-aging. No definite conclusions were reached concerning the mechanism of aging. (auth)

1835 WADC-TR-59-654

Stanford Research Inst., Menlo Park, Calif.

SYNTHESIS OF NEW HIGH TEMPERATURE MATERIALS. Period covered: June 1958 to June 1959. J. L. Engelke, F. A. Halden, and E. P. Earley. Dec. 1959. 45p. Project No. 7350. Contract AF33(616)-5888. (AD-236030).

A number of mixed transition metal carbides, borides, and nitrides were prepared and examined in terms of melting point, structure, and oxidation resistance. None of the measured melting points was higher than the value reported for HfC-4TaC (3940°C). The melting point for a series of solid solutions between HfC and NbC increased regularly with hafnium content. A material with the composition Mo_2BC, when heated in an air stream, was found to lose weight rapidly without loss of metallic character, suggesting its possible use as an ablation material. A cubic modification of hafnia was obtained in material sprayed from a plasma arc. A low coefficient of thermal expansion and high melting temperature make this a material of interest. An implosive-shock technique for compound synthesis, which subjects materials to extremely high temperature-pressure conditions for short periods of time, was developed. The method was used successfully to synthesize boron phosphide. (auth)

1836 WADD-TR-60-54

Battelle Memorial Inst., Columbus, Ohio.

CHARACTERISTICS GOVERNING THE FRICTION AND WEAR BEHAVIOR OF REFRACTORY MATERIALS FOR HIGH-TEMPERATURE SEALS AND BEARINGS. [Period covered] March 1, 1958–May 31, 1959. Lewis B. Sibley, Arthur E. Mace, Daniel R. Grieser, and C. Malcolm Allen. Jan. 15, 1960. 53p. Project title: CERAMIC AND CERMET MATERIALS. Task title: CERAMIC AND CERMET MATERIALS DEVELOPMENT. Contract AF33(616)-3995. OTS.

Various ceramic and cermet materials were evaluated for unlubricated wear resistance at high sliding speed (100 to 200 fps) and low unit load (5 to 50 psi) in 1000 to 1800°F air. A statistical correlation was obtained between the measured wear rates under these conditions and the coefficient of friction, the thermal-stress resistance, and the thermal diffusivity of the mated materials on which wear predominated. A mechanism of wear was evolved based on the above correlation and on the experimental study of

friction and wear surface-temperature fluctuations using special transducers and color-motion-picture photography. During high-speed sliding, wear appears to be induced by the inability of ceramic and cermet materials to resist thermal stresses produced by temperature gradients within each rubbing surface between small asperities or hot spots in frictional contact and the body of the respective materials. In this situation the wear rate is influenced both by the configuration of the rubbing parts and by the thermal-stress-resistance properties of the materials. Promising materials for high-temperature high-speed sliding bearings and seals include Al_2O_3–Cr–Mo cermets, SiC ceramics, and TiC–Ni–Mo cermets. (auth)

1837 WAL-TR-130.5/1
Watertown Arsenal Labs., Mass.
ETCH PITS IN PYROLYTIC GRAPHITE. Aram Tarpinian and George E. Gazza. Oct. 1960. 11p. DA Project 5B93-32-004. (PB-150917). OTS.

The observation of pits in pyrolytic graphite after ion bombardment etching is described and their similarity to dislocation etch pits is speculated. Evidence of etch-pit multiplication in the form of slip-line segments and low-angle tilt boundaries is presented. (auth)

1838 AEC-tr-4270
PARAMETERS OF ELEMENTARY CELLS OF METAL HEXABORITES. A. A. Stepanova and M. M. Umanskiĭ (Umanskiy). A translation from Bor, Trudy Konf. Khim. Bora i Ego Soedineniĭ, 1955, p.102-5 (Publ. [1958]). 5p. JCL or LC.

X-ray studies were made of the temperature dependence of unit cell parameters of LaB_6, CeB_6, PrB_6, CaB_6, and BaB_6 at 500 to 810°C. The data obtained from the x-ray photographs and Debye-grams are tabulated and discussed. (T.R.H.)

1839 CEA-tr-R-888
OXYDATION DU ZIRCONIUM À HAUTES TEMPÉRATURES ET STRUCTURE DES PELLICULES OXYDÉES PRIMAIRES. (Oxidation of Zirconium at High Temperatures and Primary Oxide Film Structure). E. S. Sarkisov, N. T. Chebotarev, A. A. Nevsorova, and A. I. Zverkov. Translated into French by B. de Trevinsky from Atomnaya Energ. 5, 550-3(1958). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 4740.

1840 CEA-tr-R-966
STRUCTURE DES GRAINS DES ALLIAGES ALUMINO-MAGNESIENS DEFORMES. (Grain Structure in Deformed Aluminum–Magnesium Alloys). V. I. Syutkina (Siutkin) (Siutkine) and E. S. Yakovlev. Translated into French from Fiz. Metal. i Metalloved. 6, 326-33(1958). 17p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 3868.

1841 JPRS-3927
EVALUATION OF THE FACTORS DETERMINING THE CHANGE IN DIFFUSION MOBILITY DURING DEFORMATION. B. S. Bokshteyn and T. I. Gubkova. Translated from Izvest. Vysshikh Ucheb. Zavedeniĭ, Chernaya Met. No. 5, 108-14(1960). 13p. OTS.

The factors affecting the change in diffusion mobility during plastic deformation of metals were evaluated. (C.J.G.)

1842 JPRS-4039
INVESTIGATION OF THE HEAT RESISTANCE OF ALLOYS OF PLATINUM WITH RHODIUM, IRIDIUM, RUTHENIUM, CHROMIUM, AND ALUMINUM BY THE BEND-TEST METHOD. (Issledovaniye Zharoprochnosti Splavov Platiny s Rodiyem, Iridiyem, Ruteniyem, Khromom i Alyumineyem Metodom Isgiba). I. I. Kornilov and R. S. Polyakova. Translated from Doklady Inst. Met. im. A. A. Baykova No. 5, 139-44(1960). 10p. OTS.

Rhodium strengthens pure platinum, but the alloys become very plastic when heated, and they bend at 900°C. The alloys of the Pt–Ir system are plastic, but their plasticity diminishes as the iridium content is increased; an alloy with 40% iridium has a 6-mm bend at 1100°C. The alloys of the Pt–Ru system have greater strength than the alloys of platinum with rhodium and iridium. An alloy with 40% ruthenium stands the assigned test conditions at 1150°C up to 5 hr. The alloys of the Pt–Al system with an aluminum content up to 7.5% are brittle and break under tension of 15 kg/sq mm before reaching 1150°C. The alloys of the Pt–Cr system have the highest heat-resistant properties. All the compositions of alloys stand heating up to 1150°C without bending. However, an increase in chromium content results in brittleness. (W.L.H.)

1843 JPRS-4045
PHYSICOCHEMICAL INVESTIGATION OF THE SiC–B_4C SECTION OF THE Si–B–C SYSTEM. (Fiziko-khimicheskoye Issledovaniye Razreza SiC–B_4C Sistemy Si–B–C). A. A. Kalinina and F. I. Shamrai (Shamray). Translated from Doklady Inst. Met. im. A. A. Baikova No. 5, 151-5(1960). 10p. OTS.

Results of a study are presented in which the SiC–C–B_4C section of the triple system Si–B–C was investigated. It is concluded that this section is quasibinary and is formed by solid solutions with limited solubility. Information on phases that occur at various temperatures is included. (J.R.D.)

1844 JPRS-4046
INVESTIGATION OF THE STRUCTURE AND PHYSICO-CHEMICAL PROPERTIES OF ALLOYS OF MOLYBDENUM DISILICIDE WITH NICKEL, COBALT, VANADIUM AND NIOBIUM. (Issledovaniye Stroyeniya i Fiziko-Mekhanicheskikh Svoystv Splavov Disilitsida Molibdena s Nikelem, Kobaltom, Vanadiyem i Niobiyem.) E. M. Savitskiĭ (Ye. M. Savitskiy) and V. V. Baron. Translated from Doklady Inst. Met. im. A. A. Baikova No. 5, 156-61(1960). 10p. OTS.

The alloys of the $MoSi_2$–Ni, $MoSi_2$–Co, $MoSi_2$–V, and $MoSi_2$–Nb sections at room temperature possess high hardness and low strength and plasticity when they contain less than 60 to 70 wt. % of the added elements. Hardness at 1000° is also high and reaches especially great values in alloys with niobium and vanadium (500 to 900 kg/sq mm). The strength of the alloys grows when the content of metals added to the $MoSi_2$ is increased above 60 to 70%, and remains high in all alloys except those with vanadium, being 200 to 250 kg/sq mm. The most promising in mechanical properties and resistance to oxidation at high temperatures are the alloys of the Mo–Si–Ni and Mo–Si–Co systems in the concentration interval from 70 to 80% Ni and from 70 to 90% Co. These alloys possess considerable strength, plasticity, and comparatively high hardness at 1000°, and can be subjected to mechanical working. The alloys with a high niobium content (80 to 90%) also possess considerable strength and very high hardness at 1000°, oxidizing moderately at high temperatures. (auth)

1845 NP-tr-486
METALLOGRAPHY (COLLECTION OF ARTICLES). (Metallovedeniya (Sbornik Statey)). Translated from a publication of the State Publishing House of Ship-Building Industry, 1958. 460p. OTS.

This collection of articles includes information on the following subjects: hydrogen embrittlement of steel; distribution of elements in metallic alloys; crystal structure

of steel; distribution of carbon in tempered Cr-Ni steel; processes in alloy steel tempering; effects of molybdenum and tungsten on steel; hardenability of steel; martensite transformations; ferritic steel brittleness; brittle steel tensile properties; failure in elastic deformation; effects of surface-active substances on fracture of steel; temperature effects on the plasticity of hardened steel; quenching and strain-hardening effects on the properties of low-carbon steel; properties of cold-drawn Al–Mg–V alloys; and titanium alloy working. Separate abstracts were prepared for 15 of the 18 included articles. (J.R.D.)

1846 NP-tr-486(p.1-53)
HYDROGEN EMBRITTLEMENT OF STEEL. L. S. Moroz and T. E. Mingin.

A discussion is presented in which conditions for occurrence of hydrogen embrittlement in steel products are examined, along with the effects of hydrogen on the mechanical properties of steel. The state of hydrogen in the crystal lattice of steel is also examined, and theories of hydrogen embrittlement are presented. Results of experiments in which the delayed rupture of hydrogen-saturated steel was examined are included. (J.R.D.)

1847 NP-tr-486(p.115-30)
THE REDISTRIBUTION OF CARBON DURING THE TEMPERING OF CHROME-NICKEL STAINLESS STEEL. B. I. Bruk and V. V. Nyrkovskaya.

Results are presented of a study in which redistribution regularities of carbon in Cr-Ni steel during tempering were investigated. C^{14} tracer was used in conjunction with 18-8 steel. It was found that treating this steel at 600°C for 6 hr leads to formation of a carbon-enriched zone along the anstenitic grain boundaries. Increasing the treatment time results in more intense diffusion. The presence of titanium inhibits the enrichment process. (J.R.D.)

1848 NP-tr-486(p.131-44)
THE USE OF THE RADIOACTIVE ISOTOPE OF HYDROGEN, TRITIUM, TO INVESTIGATE CERTAIN METALLURGICAL AND METAL-SCIENCE QUESTIONS. G. I. Nikolaev (Nikolayev) and B. I. Bruk.

Investigations are described in which the behavior of hydrogen in steel was studied using tritium. Techniques for measuring tritium activity are described, along with experimental determination of hydrogen solubility in iron using the tracer. Tracer studies of hydrogen distribution in ferritic electrode welds and in as-produced titanium and zirconium are also discussed. (J.R.D.)

1849 NP-tr-486(p.145-80)
PROCESSES DUE TO TEMPERING OF ALLOY STEELS. A. V. Zav'yalov and M. I. Senchenko.

The processes that occur during tempering of the martensite of carbon steel were examined. The effects of titanium, niobium, and other elements on these processes were also studied. Experimental data and conclusions are included. (J.R.D.)

1850 NP-tr-486(p.181-212)
THE SEPARATE AND COMBINED EFFECT OF MOLYBDENUM AND TUNGSTEN ON THE TEMPER BRITTLENESS AND HARDENABILITY OF STEEL. S. I. Sakhin, A. M. Shchegoleva, A. D. Gusarov, and E. (Ye.) M. Dubina.

Results of a study to establish the optimum content range for molybdenum and tungsten in medium alloy steel, both separately and together, are presented. Molybdenum has a narrow optimum range, whereas the Mo–W combination has a much wider range. (J.R.D.)

1851 NP-tr-486(p.213-34)
TECHNOLOGICAL METHODS OF EVALUATING THE HARDENABILITY OF CONSTRUCTIONAL STEEL AND ITS TENDENCY TO TEMPER BRITTLENESS. S. I. Sakhin.

Methods are discussed for determining the hardenability of improved steel and its sensitivity to reversible brittleness in large-cross-section specimens. These methods are based on reproduction of cooling conditions present during the heat-treatment of the items. (J.R.D.)

1852 NP-tr-486(p.235-84)
MARTENSITE AND THE MARTENSITE TRANSFORMATIONS. A. S. Zav'yalov.

A study is presented of martensite transformations in which the transformations in substitutional solutions are distinguished from those in carbon-containing iron alloys. Conclusions concerning martensite structure, carbon content and distribution, and formation mechanisms are included. (J.R.D.)

1853 NP-tr-486(p.285-315)
THE CAUSES OF THE GRAIN-SIZE EFFECT ON THE BRITTLENESS OF FERRITIC STEEL. P. O. Pashkov and V. A. Bratukhina.

The relation between grain size in ferrite-base steels and the embrittlement tendency in these alloys was investigated. The tendency to embrittlement in high temper steels after quenching is determined by the length of the lamellar-shaped grains, whereas in annealed steel with ferrite–pearlite structure the brittleness is determined by distance between slip traces. (J.R.D.)

1854 NP-tr-486(p.316-31)
STUDY OF THE STRENGTH OF NOTCHED SPECIMENS OF BRITTLE STEEL. A. A. Kroshkin and I. L. Shimelevich.

An investigation was conducted to determine the degree of plastic deformation in notched brittle material in tension failure. The value of the coefficient of stress concentration depends on temperature, notch sharpness and depth, and specimen size. (J.R.D.)

1855 NP-tr-486(p.350-66)
THE BRITTLE STRENGTH OF HARDENED STEEL. A. L. Nemchinskiĭ (Nemchinskiy).

Results from technical literature on the brittle failure of hardened steel are discussed. An accepted theory is that failure in these alloys begins with slip, and the rapid growth of brittle failure depends on the energetic condition. It also appears that the dislocation mechanism of plastic deformation plays a role in the process of brittle fracture. Experimental data indicate that the application field for hardened steel energetic condition is narrower than that for unhardened steel. Other observations on the differences between hardened and unhardened steel are included. (J.R.D.)

1856 NP-tr-486(p.367-83)
THE ROLE OF SURFACE-ACTIVE SUBSTANCES IN THE PHENOMENON OF DELAYED FRACTURE OF HARDENED STEEL. S. S. Shurakov.

Investigations to determine the effects of humidity, surface oil on specimens, and dissolved hydrogen in specimens on the phenomenon of delayed fracture in hardened steel are described. Results indicate that this phenomenon is not connected with the action of these substances. (J.R.D.)

1857 NP-tr-486(p.384-97)
THE EFFECT OF TEMPERATURE ON THE RECOVERY AND PLASTICITY OF HARDENED STEEL. S. S. Shurakov.

A study of the effects of temperature at which the recovery of hardened low-carbon steel and alloyed ferrite takes place is described. The activation energy of this process was also investigated. Steel and low-carbon chromium alloys were used in the study. Data were obtained for determining the relations of plasticity to the temperature at

which recovery takes place and to the time required for recovery. The activation energy for the process was also established. (J.R.D.)

1858 NP-tr-486(p.398-415)

COMPARATIVE STUDY OF THE EFFECT OF QUENCHING AND STRAIN HARDENING ON THE PHYSICAL AND MECHANICAL PROPERTIES OF LOW-CARBON STEEL. I. V. Gorynin.

The effects of quenching and tempering on the physical and mechanical properties of low-carbon steel were compared with the effects of strain hardening and tempering. It was found that processes taking place during the quenching of low-carbon steels are of importance; they affect the properties of steel that is quenched and of steel that is annealed after quenching. Other conclusions are also summarized. (J.R.D.)

1859 NP-tr-486(p.416-31)

THE PROPERTIES OF THE ALLOY AMg5V ON COLD-DRAWING. D. I. Baykov.

Results of tensile, compression, and flex-fatigue tests on cold-worked Al–Mg–V alloys are reported. Welded specimens were used. Results indicated that in tensile strain-hardened samples, the yield point in both tension and compression increases, whereas the strength in fatigue tests remains about constant. The strength of strain-hardened welded joints is about the same as that of joints which were not strain hardened. It was also found that strain hardening improves the strength of these alloys. (J.R.D.)

1860 NP-tr-486(p.432-56)

PLASTIC AND HOT WORKING OF CERTAIN TWO-PHASE ALLOYS OF TITANIUM. Yu. D. Khesin and S. M. Shul'kin.

Results are presented of studies concerning two-phase titanium alloys which are used to build structures for operation at room temperatures. Experimental procedures and results are discussed, and conclusions concerning the causes of β-brittleness, optimum strength conditions, and recommended working conditions are included. (J.R.D.)

1861

MICROGRAPHIC ASPECTS OF SOME FUSED AND THERMALLY TREATED Al–Mg ALLOYS. Michael L. Pinkuss (Instituto de Pesquisas Technológicas, São Paulo, Brazil). ABM (Bol. assoc. brasil. metais) (Sao Paulo) 16, 375-84 (1960). (In Spanish)

Aluminum–magnesium alloys of various compositions were prepared and studied micrographically. Correlations were made between the heat treatment and the hardness of the alloys. The fused salts used in the protection of these alloys during fusion can possess a series of characteristics, some antagonistic, which make the choice difficult. Iron increases the hardness of the precipitated alloys. In precipitation at 230°C the maximum hardness is obtained after about 10 hr of treatment in alloys with 10% magnesium. The pattern of the hardness curves as a function of time indicates that there is precipitation at room temperature. (tr-auth)

1862

THE CRYSTAL STRUCTURES OF Hf_3Al_2 AND OF $Hf_5Al_3O_x$. Lars-Erik Edshammar (Univ. of Stockholm). Acta Chem. Scand. 14, 1220(1960). (In English)

The existence of various phases in the aluminum-hafnium system was previously reported. Arc-melting followed by quenching to room temperature revealed phases having the composition Hf_3Al_2 and HfAl. Samples of compositions $HfAl_{0.5-0.7}$ gave weak lines similar to the oxygen-stabilized phase $Zr_5Al_3O_x$. This suggested isomorphism between the Hf and Zr phases was confirmed by gradually adding oxygen (as HfO_2) to the samples. The unit cell of Hf_3Al_2 was found to be tetragonal with the dimensions a = 7.535 A and c = 6.906 A. The powder pattern of $Hf_5Al_3O_x$ could be indexed assuming a hexagonal unit cell with the dimensions a = 8.066 A and c = 5.678 A. The atomic positions and space groupings are given for each of the phases. (B.O.G.)

1863

PHASE TRANSFORMATIONS IN CERIUM. C. J. McHargue and H. L. Yakel, Jr. (Oak Ridge National Lab., Tenn.). Acta Met. 8, 637-46(1960) Sept.

The room temperature crystal structure of cerium which is not cooled to lower temperatures is face-centered cubic. The face-centered cubic structure transforms upon cooling to a hexagonal close-packed structure (c/a = 3.239) with a ABAC stacking sequence of close-packed planes. This transformation has many of the typical martensitic characteristics. The transformation starts at 263° ± 10°K. At 100°K, that portion of the face-centered cubic phase which has not transformed to hexagonal close-packed begins to transform to a second face-centered cubic phase with a volume decrease of 16.5%. The kinetics of this transformation resemble that of the martensite reaction. Below a temperature between 77 and 43°K the hexagonal structure appears to transform to the collapsed cubic form. Plastic deformation at any temperature suppresses the transformation to the hexagonal form and may even cause it to revert to the normal cubic form. Deformation below 100°K favors the collapsed cubic form. Thermal cycling produces more of the hexagonal phase than can be obtained on one cooling. After a large number of cycles, neither the hexagonal nor normal cubic phase will transform to the collapsed cubic phase upon cooling. Plastic deformation at 4.2°K removes the thermal cycling effects. (auth)

1864

THE TENSILE PROPERTIES OF SOME ENGINEERING MATERIALS AT MODERATE RATES OF STRAIN. Robert F. Sreidel, Jr. and Cyril E. Makerov (Univ. of California, Livermore). Am. Soc. Testing Materials, ASTM Bull. No. 247, 57-64(1960) July.

The effect of strain rate on the dynamic strength of certain materials was investigated. Materials tested were cold-rolled steel, six aluminum alloys, six titanium alloys, uranium, and lead. Each material was tested at strain rates of 10^{-5}, 10^{-4}, 10^{-2}, and 10^{2} in. per in. per sec. The total energy absorbed in the specimen, the difference between original and final gage length, the reduced diameter, the load, and the displacement time were determined. The results are summarized in tables and graphs. The increases in yield strength varied from a negligible increase in 5456-0 aluminum to 72.9% increase for 1018 cold-rolled steel. Titanium showed a decrease in elongation with strain rate, while the aluminum and steel specimens showed an increase. (M.C.G.)

1865

CRYSTALLOGRAPHIC DATA: NIOBIUM MONOCARBIDE. E. K. Storms, N. H. Krikorian, and C. P. Kempter (Los Alamos Scientific Lab., N. Mex.). Anal. Chem. 32, 1722 (1960) Nov.

The crystal structure of NbC was reported by Becher and Ebert, who found a NaCl type lattice. A sample was prepared from –325-mesh AUC graphite and Fansteel niobium by tumbling; it was then fired at 2300°C for 3 hr in a graphite crucible. The resulting plug was pulverized to –325-mesh and rereacted at 2200°C for 3 hr. The sample was again pulverized to –325-mesh and a portion heated at 1860°C for 65 hr at a vacuum of 7×10^{-7} mm Hg.

From separate analyses for niobium, total carbon, and free carbon, the resultant empirical formula is $NbC_{0.993}$. The x-ray powder diffraction data are tabulated, with the relative intensities as visual estimates. The lattice constant was determined as $a_0 = 4.47085 \pm 0.00009$ A at 25°C; correcting for refraction in copper radiation, this value becomes 4.47095 A. The theoretical density is 7.79 g/cc and the niobium-carbon bond distance for coordination number 6 is 2.2355 A. (B.O.G.)

1866

THE DIRECT EVIDENCE OF CONSECUTIVE MICROHETEROGENEITIES TO THE PRECIPITATION OF CARBIDES IN AN AUSTENITE Fe–Ni–Cr. Jean Philibert, Charles Crussard, Xavier Wache, and Madeleine Gerber. Compt. rend. 251, 1289-91(1960) Sept. 26. (In French)

The heterogeneity of the solid austenitic solution with 36% nickel and 11% chromium was shown by means of the thermomagnetic method. Some analyses with the Castaing microsonde show that this heterogeneity is evidenced by the presence of dechromed (–3 to –4%) and overnickeled (+5 to +6%) aureoles around the precipitated carbides. (tr-auth)

1867

METHODS FOR PREPARING ALLOYS CONTAINING TITANIUM AND ZIRCONIUM FOR PHASE DIAGRAM STUDIES. V. V. Glazova and N. N. Kurnakov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 81-4(1960) July-Aug. (In Russian)

Induction heating by levitation in a high-frequency field of compacted alloy components appears to be of great interest for the study of phase diagrams, as the melt is cooled very rapidly to a solid, avoiding the harmful effects of nonequilibrium recrystallization. This is especially important for systems containing zirconium and titanium, as the solid-state diffusion is slowed down and the possibility of an allotropic transformation is reduced. The method was used for the study of the binary systems Ti–Sn, Ti–Zr, Zr–Sn, and the ternary system Ti–Zr–Sn. Tests showed that the microhardness variation from the grain boundary to the center of specimens prepared by A. A. Fogel's induction heating method (This Journal, (1959), No. 2) was negligible while variations ranging from 30 to 40 kg/mm^2 were experienced on arc-melted samples, indicating nonhomogeneity. The microhardness of the Ti–Sn system plotted as a function of the composition of the alloys resulted in two distinct curves, according to the method of preparation. The induction heating is strongly recommended for the study of the phase diagram of refractory alloys. (TTT)

1868

STRUCTURE AND PROPERTIES OF THE SOLID SOLUTIONS OF TUNGSTEN CARBIDE AND COBALT UPON ALLOYING. K. A. Bystrova, T. A. Novikova, and V. F. Funke. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 124-8(1960) July-Aug. (In Russian)

The effect of small alloying additions of chromium, molybdenum, and aluminum, widely used as additives to refractory metals, to WC–Co cermets was investigated. It was found that addition of chromium and molybdenum changed the microstructure by reducing the grain size of the WC phase; addition of aluminum had no noticeable effect on the microstructure. At the same time the additives reduced the bending strength at room temperature, chromium having the greatest effect in this respect and molybdenum having the least. All three increase the hardness. The aluminum added to the system probably forms compounds with both the cobalt and the tungsten. It is concluded that relatively slight additions can cause considerable changes in the physical properties of the cermet and should be further investigated. (TTT)

1869

STRENGTH, HARDNESS, AND STRUCTURE OF THE METAL–CERAMIC SOLID SOLUTIONS. G. S. Kreĭmer. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 129-35(1960) July-Aug. (In Russian)

Previous studies of fatigue and bending strength of WC–Co cermets as a function of cobalt content, WC grain size, and temperature, showed that the curves pass through a maximum. Current studies established the fact that cracks originate usually in the cobalt phase, the plastic deformation of which is strongly dependent on the above mentioned factors. A sudden deformation of the cobalt phase is possible only if it forms a continuous layer, without a rigid WC structure. The carbide grains must be separated from each other by the softer and more plastic cobalt phase, being similar in behavior to steels in which the hard martensitic grains are surrounded by the softer ferritic matrix. However, if the carbide grain size exceeds 5 μ, they can present sites for originating cracks. The WC grains are well wetted by the molten cobalt. (TTT)

1870

THE PHASE DIAGRAM OF THE NIOBIUM–MOLYBDENUM–VANADIUM SYSTEM AND CERTAIN PROPERTIES OF ITS ALLOYS. V. V. Baron, K. I. Ivanova, and E. M. Savitskiĭ. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 4, 143-9(1960) July-Aug. (In Russian)

Previous studies of the binary systems Nb–Mo, Nb–V, and Mo–V revealed unlimited mutual solubility of the components in both solid and liquid phases, pointing to the probability of such an unlimited solubility in the ternary system Nb–Mo–V. The phase diagram of the ternary system was determined by measuring the melting points of the various alloy compositions in the system and by studying their microstructure. The existence of unlimited solid solubility was verified. While establishing the solidus curve, it was found that the melting point is lowered from 2450 to 1800°C as the vanadium content is increased. The niobium corner of the triangular diagram presented the lowest hardness in the system, ranging from 105 to 220 kg/mm^2. The highest heat resistance was shown by alloys with high niobium content; those containing large amounts of molybdenum and vanadium were easily oxidized. The hardness measurements confirmed the existence of a continuous series of solid solutions in the system. (TTT)

1871

REFRACTORY COMPOSITIONS BASED ON SILICON–BORON–OXYGEN REACTIONS. H. F. Rizzo, B. C. Weber, and M. A. Schwartz (Aeronautical Research Labs., Wright-Patterson AFB, Ohio). J. Am. Ceram. Soc. 43, 497-504 (1960) Oct.

The nature and properties of a novel refractory material formed by reacting silicon and boron in air are described. The resulting material consists of free silicon and a new compound, SiB_4, dispersed in a borosilicate matrix. This refractory is stable in air to temperatures exceeding 1550°C, is thermal-shock resistant, and has a low density. (auth)

1872

OXIDATION STUDIES OF URANIA–THORIA SOLID SOLUTIONS. E. D. Lynch, J. H. Handwerk, and C. L. Hoenig (Argonne National Lab., Ill.). J. Am. Ceram. Soc. 43, 520-4(1960) Oct.

Nonstoichiometric solid solutions in the system UO_2–ThO_2 were formed by sintering U_3O_8–ThO_2 and codigested nitrate mixtures in air. The oxygen content of the solid so-

lutions was determined by a weight-loss method. The changes occurring in oxygen content during solid solution formation and densification were determined for a 70.4 mole % UO_2–29.6 mole % ThO_2 composition formed by sintering U_3O_8–ThO_2 in air. The first evidence of solid solution occurred at 1000°C and solution was complete above 1250°C. Thermal cycling of solid solutions in air showed a minimum oxygen-uranium ratio of 2.34 for the compositions studied. The minimum oxygen-uranium ratio obtained during thermal cycling decreased with increasing ThO_2 content. (auth)

1873

PHASE EQUILIBRIA IN THE SYSTEM IRON OXIDE–Cr_2O_3–SiO_2 IN AIR. Arnulf Muan and Shigeyuki Sōmiya (Pennsylvania State Univ., University Park). J. Am. Ceram. Soc. 43, 531-41(1960) Oct.

Phase equilibrium data, obtained by the quenching technique, are presented for the liquid temperature region of the system iron oxide–Cr_2O_3–SiO_2 in air, which represents an O_2 isobaric section (p_{O_2} = 0.21 atm) through the quaternary system Fe–Cr–Si–O at a total pressure of 1 atm. The diagram is dominated by a large area of coexistence of two immiscible liquids, and high liquid temperatures prevail throughout most of the system. Possible applications to refractory problems are indicated. (auth)

1874

PROPERTIES OF VANADIUM–COLUMBIUM ALLOYS. S. T. Wlodek (Union Carbide Metals Co., Niagara Falls, N. Y.). J. Electrochem. Soc. 107, 923-9(1960) Nov.

The development of a series of V–Nb alloys is described. The exploitation of this alloy system allows the design of high-strength, low-density compositions possessing good aqueous corrosion resistance in boiling, oxidizing, or reducing acids and sufficient oxidation resistance to allow their fabrication by conventional hot-working techniques in air. In the warm-worked condition, the spectrum of properties measured under inert atmosphere conditions (strain rate 0.005^{-1} sec) includes ultimate tensile strengths of 120,000 to 35,000 psi over the temperature range of 700 to 1000°C and stress-rupture properties at 700°C corresponding to 100-hr life at stresses in excess of 100,000 psi. Tensile strengths as high as 70,000 psi at 1000°C and 40,000 psi at 1200°C were observed at higher rates of loading in the warm-worked and stress-relieved conditions. (auth)

1875

PREPARATION AND CRYSTAL STRUCTURE OF AMERICIUM METAL. D. B. McWhan (Univ. of California, Berkeley), J. C. Wallmann, B. B. Cunningham, L. B. Asprey, F. H. Ellinger, and W. H. Zachariasen. J. Inorg. & Nuclear Chem. 15, 185-7(1960) Sept. (In English)

The crystal structure of americium was studied using metals produced by two different methods. The methods used in preparing the metal are described. Diffraction data are presented for the metal, comparing observed values with those calculated for crystals indexed as double hexagonal close-packed, hexagonal close-packed, and face centered cubic, and for AmO. The results are compared with results obtained previously. Magnetic susceptibility measurements and high temperature x-ray studies are in progress. (B.O.G.)

1876

INTERNUCLEAR DISTANCES IN HYDRIDES. Thomas R. P. Gibb, Jr. and David P. Schumacher (Tufts Univ., Medford, Mass.). J. Phys. Chem. 64, 1407-10(1960) Oct.

Metal-hydrogen internuclear distances in substantially all the known binary metallic and saline hydrides may be rationalized equally well on the basis of an ionic model or on the basis of a model utilizing delocalized covalent bonding. In the former the anionic radius (CN = 4) of hydrogen is 1.29 A; the cation radius is for the ion of maximum normal oxidation number. The internuclear distances in the Group I saline hydrides are shown to be increased by the anion-repulsion factor of Pauling. The covalent model is that suggested by Pauling for application to metals and employs a single-bond radius of 0.37 A for hydrogen. Both models are applicable to saline as well as to metallic binary hydrides. (auth)

1877

SOME SOLIDUS TEMPERATURES IN SEVERAL METAL–CARBON SYSTEMS. M. R. Nadler and Charles P. Kempter (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 64, 1468-71(1960) Oct.

Minimum eutectic temperatures were determined for systems involving carbon and some refractory metals. These solidus temperatures for the systems C-, Ta, Os, W, Re, Nb, Ir, Mo, Ru, 50 Ir–50 Rh, Pt, Rh, and Pd are 2902, 2732, 2732, 2486, 2328, 2296, 2210, 1942, 1932, 1736, 1694, and 1504°C, respectively. For the Nb–C system, the Nb_2C peritectic and the NbC–C eutectic are located at 3080 and 3220°C, respectively. For the Ta–C system, the Ta_2C peritectic and the TaC–C eutectic are located at 3500 and 3710°C, respectively. The melting points of Mo_2C, WC, and NbC are 2410, 2720, and 3480°C, respectively. (auth)

1878

THE NIOBIUM–NIOBIUM CARBIDE SYSTEM. E. K. Storms and N. H. Krikorian (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem. 64, 1471-7(1960) Oct.

The solid portion of the Nb–NbC phase diagram was determined. The following characteristic temperatures were measured: a eutectic temperature between $NbC_{0.08}$ and $NbC_{0.39}$ of 2335 ± 20°C, a peritectic temperature between $NbC_{0.52}$ and $NbC_{0.56}$ of 3090 ± 50°C and a melting point maximum at about $NbC_{0.86}$ of 3500 ± 75°C. Congruent vaporization in vacuo takes place at a composition near $NbC_{0.71}$ at 2800°C. Below 2000°C Nb_2C has a very narrow range of homogeneity. Lattice parameters for the Nb_2C phase in equilibrium at the phase boundary were found to be a_0 = 3.128 ± 0.001 A., c_0 = 4.972 ± 0.001 A, when NbC was present and a_0 = 3.126 ± 0.001, c_0 = 4.965 ± 0.001 and the Nb phase was detected. In both cases c/a = 1.59. The narrowness of the homogeneity range seems to preclude the possibility of obtaining a reliable relationship between composition and lattice parameter in this region. (auth)

1879

WHY TO USE TITANIUM AND ZIRCONIUM CASTINGS. W. A. Aschoff (Oregon Metallurgical Corp., Albany). Materials in Design Eng. 51, No. 1, 102-4(1960) Jan.

Titanium and zirconium castings for units handling highly corrosive chemicals are considered, and the extended-service life of the metals is discussed. Because of the high nuclear efficiency of titanium and zirconium, a reactor component from these materials can use a lower enrichment level and, therefore, cheaper fuels than those designed with stainless steel. Current commercial alloys exhibit strength-density ratios greater than 850,000. Typical properties of cast titanium and zirconium and relative costs as compared with stainless steel and high nickel-chromium alloy castings are given. (M.C.G.)

1880

RHENIUM–A PROMISING REFRACTORY METAL. John Port (Chase Brass and Copper Co., Waterbury, Conn.). Materials in Design Eng. 51, No. 6, 140-2(1960) June.

The properties of rhenium and specialized applications of its alloys are discussed. Its mechanical properties are listed. When molybdenum–rhenium alloys were used as filler metal in tungsten inert arc welding, resulting welds were found to have startling ductility at room temperature. Rhenium–tungsten and rhenium–molybdenum thermocouples provided a significant breakthrough in the accurate treatment of extremely high temperatures. Use of rhenium for electrical contacts was investigated. In heaters and filaments in electron tubes, the three principle advantages of rhenium over tungsten are that it has a greater resistance to the water-cycle effect, does not form stable carbides, and does not become brittle on recrystallization. (M.C.G.)

1881

INTRODUCTION TO HIGH TEMPERATURE METALS. Jack C. Merriam. Materials in Design Eng. 51, No. 6, 143-58(1960) June.

The problems encountered by structural metals at temperatures from 1200 to 2500°F and the materials that may be used in solving these problems are discussed. Extensive information is given for iron-, nickel-, and cobalt-base superalloys; refractory metals and alloys; and borderline and potential materials. The stress-time-temperature parameters and structural stability are the properties considered in selecting materials for high-temperature applications. The performances of the various materials under similar conditions are compared. (M.C.G.)

1882

HIGH TEMPERATURE STRUCTURAL CERAMICS. F. H. Simpson (Aero-Space Div., Boeing Airplane Co. [Seattle]). Materials in Design Eng. 52, No. 4, 16-18(1960) Oct.

Hafnium titanate ceramics combine low thermal expansions with unusually high melting points. The effects of temperature on strength and the effects of altering titania-hafnia proportions on thermal expansion are shown. The elastic moduli of these ceramics are lower than most ceramic oxides. Water quenching was found to be definitely detrimental to the material. (M.C.G.)

1883

MATERIALS FOR PORTABLE NUCLEAR REACTORS. Edward J. Mullarkey (Lead Industries Assn., New York). Materials in Design Eng. 52, No. 4, 107-14(1960) Oct.

The properties of materials for fuel, control, and shielding for portable nuclear reactors are discussed. The fuel materials can be liquid or solid and are usually enriched with U^{235} to reduce size. Control rods used include aluminum-clad cadmium and stainless steel. The properties of water, beryllium, graphite, and organic materials as moderators are discussed. The most useful reflector material for portable reactors is lead. Important savings in weight and costs are obtained when it is used in the dual role of reflector and gamma shield. Thermal shielding is not needed in small portable reactors because of their low power levels. Lead, concrete, and water are the most common materials used for biological shielding in portable reactors. (M.C.G.)

1884

SMALL-ANGLE SCATTERING OF X-RAYS FROM DEFORMED NATURAL GRAPHITE. Eitaro Matuyama (Yamaguchi Univ., Ube, Japan). Nature 188, 218-19 (1960) Oct. 15.

Examinations of deformed metals using x-ray small-angle scattering techniques were stimulated by the development of theories and experiments on defects in crystals. Some results of the examinations of natural graphite are presented. The graphite was deformed by either rolling, extruding, pressing, or Lamellar compounding. The determination of scattering was achieved by exposure, under constant operating conditions, on the same photographic film. Representative scattering curves are plotted, showing that scattering is almost linear over the range of angles observed and is approximately parallel for different deformations. The angular dependence of the scattered intensity was compared with that of stressed copper and aluminum in the same angular range. (B.O.G.)

1885

PLUTONIUM–ALUMINUM SOLID SOLUBILITY AND DIFFUSION STUDIES. Arthur E. Hall (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. 8, 283-8(1960) Oct.

The solid solubility and diffusion of plutonium in aluminum were studied at 600°C. Cylindrical diffusion couples were prepared by coextrusion, and consisted of a core of 7 wt. % plutonium-93% aluminum alloy clad with aluminum. Quantitative autoradiography was utilized to determine the solid solubility, while metallographic measurement furnished data for calculation of a diffusion coefficient. (auth)

1886

THE SURFACE TENSIONS OF LIQUID METALS AT THEIR MELTING POINTS. Simon W. Strauss (U. S. Naval Research Lab., Washington, D. C.). Nuclear Sci. and Eng. 8, 362-3(1960) Oct.

In an attempt to correlate surface tensions of liquid metals with other properties, an investigation was made to determine if the Hildebrand and Scott equation or a modification of it could be applied to a large number of liquid metals at their melting points. The results were plotted as log γ (surface tension) vs. log s (energy of vaporization per unit volume). This plot could not be improved by using as Hildebrand and Scott did, log $(\gamma/v^{\frac{1}{3}})$, where v is molecular volume, for the ordinate. (M.C.G.)

1887

SOME ELASTIC AND THERMAL PROPERTIES OF ZIRCONIUM AND TUNGSTEN. A. Myers (The University, Leeds, Eng.). Phil. Mag. (8) 5, 927-38(1960) Sept.

The longitudinal and shear wave velocities of 10 Mc/sec ultrasonic waves were measured in polycrystalline specimens of zirconium and tungsten at temperatures between 14 and 300°K and the elastic constants calculated from these measurements. The difference between the specific heats at constant pressure and at constant volume in these metals at various temperatures was calculated by means of the thermodynamic relation involving the bulk modulus of the metal. This difference was used in the examination of a suggested method of obtaining the γ values, and hence the electronic specific heats of metals. It was found that the γ values for zirconium and tungsten estimated by this method are greater by factors of about 1.3 and 2.8, respectively, than the values obtained from low-temperature calorimetric determinations. For a number of reasons, which are discussed, close agreement is not to be expected; no satisfactory explanation for the very wide discrepancy was found. (auth)

1888

PROPERTIES OF GRAPHITE. PART I. PREPARATION, STRUCTURE AND MECHANICAL PROPERTIES. L. C. F. Blackman (Imperial Coll. of Science and Tech., London). Research (London) 13, 390-7(1960) Oct.

Some of the important aspects of the knowledge of the properties of graphite and its crystal compounds are discussed. Special attention is given to the influence of structural and chemical imperfections on the various properties of graphite. (auth)

1889

HIGH-TEMPERATURE SHORT-TIME CREEP OF GRAPHITE. H. E. Martens, L. D. Jaffe, and D. D. Button (California Inst. of Tech., Pasadena). Trans. Met. Soc. AIME 218, 782-7(1960) Oct.

Constant-load tensile creep properties were determined at 3000 to 5300°F. Creep rates of 10^{-7} to 10^{-3} sec^{-1} were observed at stresses of 1600 to 4000 lb/sq in. The creep rate increased continuously with increasing temperature, and was lower when the stress was parallel to the grain rather than perpendicular. Elongations of 40% and density decreases of 18% were observed. Activation energies of 159 to 240 kcal/mole were obtained. (auth)

1890

HIGH-TEMPERATURE SLIP IN TUNGSTEN. Sam Leber and J. W. Pugh (General Electric Co., Cleveland). Trans. Met. Soc. AIME 218, 791-3(1960) Oct.

Single crystals of tungsten were made and deformed in tension at 3000°C. The slip traces so formed on these crystals were analyzed to determine the apparent slip system. Results indicate that deformation occurs in the <111> direction on planes of maximum shear stress. This determination agrees with the early work of Taylor and Elam on other body-centered cubic crystals at low temperatures. (auth)

1891

MEASUREMENT OF KIRKENDALL EFFECT IN THE IRON–CHROMIUM SYSTEM. H. W. Paxton and E. J. Pasierb (Carnegie Inst. of Tech., Pittsburgh). Trans. Met. Soc. AIME 218, 794-6(1960) Oct.

Markers in a diffusion couple in the chromium–iron system move toward the high chromium side indicating $D_{Cr} > D_{Fe}$ at the marker composition. By a combination of measurements of D^*_{Cr} and D as a function of composition, this is shown independently. D^*_{Fe} is calculated as a function of composition, and shown to be in reasonable agreement with measured values by other workers. (auth)

1892

THE ABSORPTION AND EFFUSION OF HYDROGEN IN ALPHA IRON. D. C. Carmichael (Battelle Memorial Inst., Columbus, Ohio), J. R. Hornaday, A. E. Morris, and N. A. Parlee. Trans. Met. Soc. AIME 218, 826-32(1960) Oct.

Rates of absorption and effusion of hydrogen in solid iron were measured by a Sieverts type of apparatus. With clean α iron these rates are diffusion controlled down to 420°C and are represented by the equation $D = 6.70 \times 10^{-4}\, e^{-1100/T°K}$ $cm^2\ sec^{-1}$. Certain surface impurities can affect these rates at all temperatures. Thin oxide films lower the apparent diffusivity of annealed iron markedly. Cold-worked iron (75%) annealed at 430°C has practically the same solubility and diffusivity as annealed iron. (auth)

1893

THE ROLE OF STRESS IN HYDROGEN INDUCED DELAYED FAILURE. E. A. Steigerwald (Thompson Ramo Wooldridge, Inc., Cleveland), F. W. Schaller, and A. R. Troiano. Trans. Met. Soc. AIME 218, 832-41(1960) Oct.

The initiation of localized cracking in hydrogenated high-strength steel was dependent on the development of a critical hydrogen concentration and relatively insensitive to the magnitude of the applied stress. The stress was believed to influence the delayed failure process by providing the means for grouping the hydrogen. On the basis of an assumed distribution law the observed changes in the lower critical stress as a function of notch acuity, yield strength, and temperature were predictable over a significant range of these variables. (auth)

1894

YTTRIUM–NICKEL SYSTEM. B. J. Beaudry and A. H. Daane (Ames Lab., Ames, Iowa). Trans. Met. Soc. AIME 218, 854-9(1960) Oct.

The nickel-yttrium system was investigated by metallographic, thermal, and x-ray methods. Nine intermetallic compounds are present: Y_3Ni, Y_2Ni_2, YNi_2, YNi_3, Y_2Ni_7, YNi_4, and Y_2Ni_{17} which undergo peritectic decomposition, and YNi and YNi_5 which melt congruently. There are eutectics at 34.8, 57.5, and 93.3 at. % niobium which melt at 805, 950, and 1285°C, respectively. Crystallographic data are given for YNi, YNi_2, YNi_3, YNi_5, and Y_2Ni_{17}. The terminal solid solubility is low. (auth)

1895

THE STRESS-INDUCED ORDERING INTERNAL FRICTION OF IRON-RICH ALLOYS OF IRON AND ALUMINUM. J. C. Shyne (Ford Motor Co., Dearborn, Mich.) and M. J. Sinnott. Trans. Met. Soc. AIME 218, 861-5(1960) Oct.

Low-frequency mechanical damping measurements were made to investigate internal friction in Al-Fe alloys. The atomic ordering of the Al-Fe system strongly influenced the stress-induced ordering internal friction. Magnetoelastic damping was encountered and was shown to be reduced by the application of a static stress. (auth)

1896

RARE-EARTH COMPOUNDS WITH THE $MgCu_2$ STRUCTURE. J. H. Wernick and S. Geller (Bell Telephone Labs., Murray Hill, N. J.). Trans. Met. Soc. AIME 218, 866-8 (1960) Oct.

A number of new AB_2 compounds, in which A is a rare earth or yttrium atom and B is Al, Mn, Fe, Co, or Ni, having the cubic $MgCu_2$ structure (Laves phase), are reported. In most of the compounds, the interatomic distances are normal; the lanthanide contraction is observed. In the compounds CeB_2, B = Fe, Co, Ni, Ce appears to have a valence substantially greater than three; in $CeAl_2$, cerium appears to be trivalent. These results are interpreted as resulting from an energetically more favorable situation for the 4f electron of cerium to be lost to the 3d band of iron, cobalt, and nickel. Evidence for the existence of homogeneity ranges in these compounds is presented. (auth)

1897

DEFORMATION MODES OF ZIRCONIUM AT 77°, 575°, AND 1075°K. E. J. Rapperport and C. S. Hartley (Nuclear Metals, Inc., Concord, Mass.). Trans. Met. Soc. AIME 218, 869-76(1960) Oct.

The only slip system observed in zirconium crystals deformed at 77, 575, and 1075°K was $(10\bar{1}0)$ $[\bar{1}2\bar{1}0]$ with a critical resolved shear stress in tension of 1.0 kg/mm^2 at 77°K; 0.2 kg/mm^2 at 575°K; and 0.02 kg/mm^2 at 1075°K. The active twin planes were $\{10\bar{1}2\}$, $\{11\bar{2}1\}$, $\{11\bar{2}2\}$, and $\{11\bar{2}3\}$ with varying temperature dependence. A detailed analysis for the slip direction using Laue spot asterism is appended. (auth)

1898

MECHANICAL PROPERTIES OF TANTALUM METAL CONSOLIDATED BY MELTING. M. Schussler (Union Carbide Metals Co., Niagara Falls, N. Y.) and J. S. Brunhouse, Jr. Trans. Met. Soc. AIME 218, 893-900(1960) Oct.

Arc-melted and electron-beam-melted tantalum in the cold-worked and the recrystallized conditions showed high strength, good tensile ductility, and excellent notch toughness down to −321°F. Arc-melted material, containing moderate amounts of interstitials, possessed better short-time strength than higher purity electron-beam-melted material up to 2000°F. Cold-working substantially strengthened arc-melted tantalum, whereas, electron-beam-melted material exhibited a low work-hardening rate and possessed better formability characteristics. With identical compo-

sitions and microstructures, the mechanical properties of melted tantalum and vacuum-sintered tantalum should be similar. (auth)

1899

PHASE RELATIONSHIPS IN THE SYSTEMS Fe–Pb–Ni, Fe–Ni–C(SAT) AND Fe–Pb–Ni–C; 1300° TO 1550°C. K. O. Miller and J. F. Elliott (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME 218, 900-10(1960) Oct.

Solubility studies were carried out to establish the phase distributions for various Fe-Ni-Pb-C alloys at temperatures where the metallic components exist as liquid solutions. Temperature as a function of composition diagrams for the Ni-Pb, Fe-Pb, Fe-Ni-Pb, and Ni-Pb-C systems is derived by employing various approximations in conjunction with the data. Results are summarized for 1550°C in a quaternary phase diagram of the Fe-Ni-Pb-C system. (auth)

1900

THE TANTALUM–RHENIUM SYSTEM. J. H. Brophy, P. Schwarzkopf, and J. Wulff (Massachusetts Inst. of Tech., Cambridge). Trans. Met. Soc. AIME 218, 910-14(1960) Oct.

A constitutional diagram was proposed for the Re-Ta alloy system. Rhenium dissolved in tantalum to 48 wt. %, and the maximum solubility of tantalum in rhenium is 5 wt. %. Intermediate χ and σ phases were found. X-ray diffraction, metallography, and melting points were employed. (auth)

1901

SOME HIGH-TEMPERATURE PROPERTIES OF COPPER–ZIRCONIUM AND COPPER–CHROMIUM HIGH-CONDUCTIVITY ALLOYS. Matti J. Saarivirta and Pierre P. Taubenblat (Amco Research and Development, Inc., Carteret, N. J.). Trans. Met. Soc. AIME 218, 935-9(1960) Oct.

Some high-temperature properties are given for Cu–Zr conductor alloy compared to Cr–Cu alloy. Definite superiority of the Cu–Zr alloy over the Cr–Cu alloy at high temperatures is shown. (auth)

1902

ÜBER DIE ZUSTANDSVERHÄLTNISSE IM SYSTEM Al–Si–C–O ZWISCHEN 1600 UND 2200°C ALS GRUNDLAGE DER THERMISCHEN REDUKTION VON TONEN. (The State Behavior in the System Al–Si–C–O Between 1600 and 2200°C as a Basis for Thermal Reduction of Clays). Hubert Wittner. Thesis, Berlin-Charlottenburg, Technische Universität, 1959-60. 18p.

A study was made of the production of Al–Si compounds with high aluminum content from clays. A knowledge of the system Al–Si–C–O at 1600 to 2200°C was needed and acquired. (T.R.H.)

1903

THERMOELECTRIC PROPERTIES OF SOME RARE EARTH SYSTEMS. R. C. Vickery, H. M. Muir, and E. V. Kleber (Nuclear Corp. of America, Burbank, Calif.). Paper No. 1275-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 5p.

Compositions of gadolinium with other metals and metalloids were examined for value as high-temperature thermoelectric materials. In systems containing Bi, Sb, Si, B, P, Fe, Ni, Co, and Mn, Seebeck emfs and resistivities are generally low (20 to 30 μv/°C and 200 to 400 $\mu\Omega$-cm, respectively). However, the gadolinium-selenium system presents intermetallic compounds with Seebeck outputs up to 600 μv/°C and resistivities ranging from 0.2 to 1000 $\times$ 10^{-3} Ω-cm. Specific considerations are made of the potential of this system. (auth)

1904

A NUCLEAR-THERMIONIC FUEL ELEMENT TEST. R. C. Howard, L. Yang, H. L. Garvin, and F. D. Carpenter (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Paper No. 1287-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 5p.

An in-pile test of a nuclear-thermionic cell was conducted to determine feasibility and performance. The emitter was composed of 95% by weight UC, the uranium 93% U^{235}, and 5% ZrC. A copper anode was used. The entire assembly was housed in an aluminum tube. The performance of the cell during experimental runs was satisfactory. A decrease in cell output during the course of the experiment was caused by evaporation of the cathode and condensation on the anode. The over-all mechanical stability of the emitter was an outstanding feature of the test. (M.C.G.)

1905

MECHANICAL PROPERTIES OF INTERMETALLIC COMPOUNDS. J. H. Westbrook, ed. A Symposium held during the 115th Meeting of the Electrochemical Society at Philadelphia, Pennsylvania, May 3-7, 1959. New York, John Wiley & Sons, Inc., 1960. 446p.

Seventeen papers are included which were presented at a symposium held in Philadelphia on May 5 to 6, 1959. (Separate abstracts have been prepared for three.) The subjects of the papers are effects of crystal structure and temperature, experimental techniques for studying mechanical properties, effects of dislocations and point defects, and properties of specific compounds. Some of the compounds treated are NiAl and Ni_3Al (fractography), Cu–Au alloys (domain structure), TiAl (radiation effects), InSb, transition metal beryllides, Cu–Al alloys (plasticity of complex phase), intermetallic compounds of transition metals, and Fe–Ni alloys. (D.L.C.)

1906

MECHANICAL PROPERTIES OF SOME TRANSITION ELEMENT BERYLLIDES. A. J. Stonehouse, R. M. Paine, and W. W. Beaver (Brush Beryllium Co., Cleveland). p.297-319 of "Mechanical Properties of Intermetallic Compounds."

The mechanical properties of beryllides of Nb, Ta, Zr, Mo, and Ti at 2300 to 3000°F were investigated, especially $NbBe_{12}$, $ZrBe_{13}$, $TaBe_{12}$, Nb_2Be_{17}, Zr_2Be_{17}, and Ta_2Be_{17}. $MoBe_{12}$ and $TiBe_{12}$ were studied to a lesser extent along with samples with the nominal composition of $NbBe_{11}$ and $TaBe_{11}$. The transverse rupture machine used in the experiments is described. The high-temperature strength and oxidation resistance of beryllides indicate possible use as high-temperature alloys. (D.L.C.)

1907

INTERMETALLIC COMPOUNDS OF THE TRANSITION METALS AND THEIR HIGH TEMPERATURE PROPERTIES. R. D. Grinthal (Firth Sterling, Inc., Yonkers, N. Y.). p. p.337-43 of "Mechanical Properties of Intermetallic Compounds."

A survey program was conducted on whether intermetallic compounds can be used as high-temperature materials, and a survey of literature and published phase diagrams was used to choose compounds for testing. An arbitrary lower limit of 1400°C was set on the melting point, and some systems, e.g., some of those of Zr, V, and Mn, were rejected because of complications or undesirable properties. The

result was that only a few showed any promise and none were superior to carbides, borides, and silicides that are commonly used as high-temperature materials. NiAl, TiAl, $LaAl_2$, $DyAl_2$, and Cr_2Ti were investigated, and their strengths were determined at 20 and 1000°C. The effects of the addition of a third metal on the strength were investigated for NiAl with Cr, Nb, Ti, and Zr as additive and for Cr_2Ti with Cu and Mo as additive. (D.L.C.)

1908

PLUTONIUM–URANIUM ALLOY. (to U. S. Atomic Energy Commission). British Patent 849,713. Sept. 28, 1960.

Pu-U alloys suitable for use as fuel in fast breeder reactors and having good fabrication characteristics can be prepared by mixing an alloy comprising Pu and U in the ratios 1:9 to 1:1 and 7 to 40 at. % Fe, Ni, Co, and/or Mn. The latter group of metals does not moderate or capture fast neutrons and improves the working properties of the alloy by keeping the amount of the ζ phase small. From 7 to 40 at. % of these metals will keep the ζ phase small, although 14.3 at. % is the amount that will form the preferred tetragonal crystal structure of the U_6Mn type. Six examples of the preparation of such alloys are given. (D.L.C.)

Radiation Effects

1909 AD-236131

Stevens Inst. of Tech., Hoboken, N. J.

UNCLASSIFIED LITERATURE SURVEY ON THE EFFECTS OF NUCLEAR RADIATION TO ELECTRON TUBE MATERIALS. Quarterly Report No. 11 for December 1, 1959 to February 29, 1960. E. R. Johnson. 24p. DA Project No. 3-19-01-001-01. Contract DA-36-039-SC-73146.

The effects of radiation on electron tubes and tube components are reviewed. Data on the outgassing of glass enclosures and plates by electron bombardment are reviewed. (For preceding period see AD-232188.) (C.J.G.)

1910 CF-54-12-212

Oak Ridge National Lab., Tenn.

METALLOGRAPHIC EXAMINATION OF P&W CAPSULES 1-10 AND 1-11. M. J. Feldman, W. B. Parsley, R. N. Ramsey, and A. E. Richt. Dec. 29, 1954. Decl. June 13, 1960. 41p. OTS.

Results of the metallographic examination of P and W capsules 1-10 and 1-11 are reported. Hardness and bend tests were made on the irradiated capsules. Results are reported. Examination of the capsules in the as-irradiated condition revealed that cracking had taken place as a result of the irradiation. (W.L.H.)

1911 KAPL-2091

Knolls Atomic Power Lab., Schenectady, N. Y.

THE EFFECTS OF REACTOR IRRADIATION ON THE THERMOELECTRIC PROPERTIES OF LEAD AND BISMUTH TELLURIDES. J. C. Corelli and R. T. Frost. Apr. 1, 1960. 44p. Contract W-31-109-Eng-52. OTS.

Commercially available specimens of polycrystalline n- and p-type lead telluride and n- and p-type bismuth telluride were irradiated in the Engineering Test Reactor. Total integrated flux times of 1.5×10^{20} neutrons/cm^2 (thermal) and 1.6×10^{19} neutrons/cm^2 (fast, i.e., for neutrons having energies greater than 1 Mev) were accumulated by the specimens during irradiation. The specimen temperature during irradiation was 60 ± 20°C. The effects of the irradiation on the thermoelectrical properties of these materials were found to be due almost entirely to fast neutrons insofar as most of the damage is healed during heat treatment. Increases in the electrical resistivity for irradiated n type PbTe and Bi_2Te_3 were found to anneal at temperatures below 200°C. Measurements of the electrical resistivity and Seebeck coefficient as a function of temperature for irradiated and unirradiated samples cut from the same ingot are given for all materials except p type PbTe. For the latter sample only the measurements of the Seebeck coefficient are given. (auth)

1912 NP-8979

Boeing Airplane Co., Seattle.

RADIATION DAMAGE TO 2N491 SILICON UNIJUNCTION TRANSISTOR AND C35 SILICON CONTROLLED RECTIFIER. Harry P. S. Gee. Dec. 1, 1959. 9p. (APS71/RSG-7).

Radiation damage tests revealed that 2N491 silicon unijunction transistors can be employed in an integrated fast-neutron environment up to 3×10^{12} neutrons/cm^2 and C35 silicon controlled rectifiers up to 5×10^{12} neutrons/cm^2. (C.J.G.)

1913 NP-9280

Admiral Corp., Chicago.

EVALUATION-DEVELOPMENT OF MIL-C-14157 CAPACITORS FOR NUCLEAR RADIATION ENVIRONMENT. Scientific Report No. 3. E. R. Pfaff. May 1960. 77p. Contract Nobsr-77612.

In environmental tests 49 of the 50 irradiated samples failed within 154 hr. Of the 50 control samples, 18 are remaining on test after 400 hr. The irradiated group with the pulsed voltage applied, failed rapidly after 65 hr indicating a possible structural change in the units. After 300 hr of irradiation Mylar and Kraft paper was extremely brittle and the units had high internal gas pressure. Preliminary studies of FS-5 and FC-43 dielectric fluid indicate that they evolve Fluorine gas during irradiation. Capacitors impregnated with C_{16-18} alkyl biphenyl dielectric fluid and solid impregnants are being investigated. (auth)

1914 NP-9281

Admiral Corp., Chicago.

EVALUATION-DEVELOPMENT OF MIL-C-14157 CAPACITORS FOR NUCLEAR RADIATION ENVIRONMENT. Scientific Report No. 4. E. R. Pfaff. Aug. 1960. 130p. Contract Nobsr-77612.

In the second environmental test all of the irradiated samples failed in 312 hr. Twenty-one of the 50 control units remained on test at 320 hr. Units with C_{16-18} alkyl biphenyl dielectric fluid failed very rapidly. The failure rate for the bis(phenoxyphenyl) ether unit was similar to the standard unit and slightly lower for the monoisopropylbiphenyl unit. With the special units the gas formation is no longer a problem. The addition of inhibitor may improve the gamma failure rate of these units significantly and the use of the larger group will improve the statistical significance of the results. (auth)

1915 TID-6518

Northwestern Univ. Evanston, Ill.

MECHANISM OF HIGH ENERGY RADIATION EFFECTS IN POLYETHYLENE. Technical Report No. 5 covering Period March 1, 1959 to March 1, 1960. Malcolm Dole. Mar. 15, 1960. 6p. Project 9. Contract AT(11-1)-89. OTS.

The irradiation of polyethylene to 117 Mrad produced no change in the solubility of hydrogen. $H-D_2$ exchange reactions were studied during the irradiation of polyethylene. G-values for crosslinking and scissioning were determined for atactic and isotactic polypropylenes. (For Part IV see NSA Vol. 13, abstract No. 16047.) (C.J.G.)

1916 CEA-tr-R-976

EFFETS DU RAYONNEMENT NEUTRONIQUE SUR LA STRUCTURE ET LES PROPRIÉTÉS DES ACIERS FERRITO-PERLITIQUES. (Effects of Neutron Radiation on the Structure and Properties of Ferrito-Perlitic Steels). V. S. Lyashenko (Liashenko) and Sh. Sh. Ibragimov (Ibragimov). Translated into French from Atomnaya Energ. 6, 277-80(1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 12698.

1917

RADIATION-INDUCED CONDUCTIVITY IN INSULATORS. H. J. Wintle (Royal Military Coll. of Science, Swindon, Wilts, Eng.). Brit. J. Radiol. 33, 706-7(1960) Nov.

It is shown that experimental results from many sources are consistent with the relation $\sigma = 10^{-18}$ R where σ is the induced conductivity in Ω^{-1} cm^{-1} and R the dose-rate in rad minute^{-1}. Polythene is an exception and the relation $\sigma = k R^{0.7}$ is found to hold over a wide range of dose rate. (auth)

1918

ON THE RADIATION DAMAGE OF ELECTRICAL INSULATING MATERIALS. Motosuke Munakata, Junpei Asahara, Masao Yamada, Toshio Kashimura, Motonori Kanazashi, and Hiroshi Yoshioka. Denki Shikenjo Chôsa Hôkoku No. 146, 1-130(1957). (In Japanese)

An investigation of reports and a collection of data were made on radiation damage of insulating materials. These data are classified by both materials and properties, and the grade of the stability to decline of mechanical, electrical, and physical properties are compared. The chemical mechanisms of radiation damage to high polymeric insulating materials are reviewed. Suggestions are made for the choice of insulating materials used in an atomic pile. (auth)

1919

RADIATION-INDUCED CHANGES IN SOME PHYSICAL PROPERTIES OF GRAPHITES OF VARIOUS DEGREES OF GRAPHITIZATION. Yu. (Iu.) N. Alkesenko and L. E. Kakushadze. Intern. J. Appl. Radiation and Isotopes 8, 131-2(1960) July. (In English)

The absolute radiation-induced changes in electrical and thermal resistivities are, within the accuracy of the measurements, independent of the degree of graphitization. The relative changes in electrical resistivity and thermal conductivity are smaller for the less graphitized samples. The relationship between thermal conductivity and temperature indicates that the radiation-induced breakdown of the crystal lattice in graphite has the same effect on the propagation of thermal vibrations as the crystallite boundaries or impurities. The mechanism by which radiation affects the electrical conductivity of graphite appears to be that of forming additional traps for the current carriers. This suggestion is confirmed by the radiation-induced changes in the Hall coefficient which were observed previously. Swelling was practically absent in the experiments, which suggests that this phenomenon is due to less stable forms of radiation damage. It must be pointed out that if graphite is irradiated at room temperature, the swelling effect is quite stable, and is only removed by annealing at temperatures of at least ~2000°C. This suggests that radiation annealing occurred during the experiments, in virtue of the fact that certain crystal lattice defects are considerably less stable under the simultaneous action of heat and radiation than under the action of heat alone. (auth)

1920

THE CONDUCTIVITY OF POLYTHENE UNDER GAMMA IRRADIATION. H. J. Wintle (Royal Military Coll. of Science, Swindon, Wilts, Eng.). Intern. J. Appl. Radiation and Isotopes 8, 132-4(1960) July. (In English)

The electrical conductivity of specimens of polythene film was measured in vacuo with and without gamma irradiation. The specimens were 0.005 in. thick, and silver electrodes were evaporated onto each side of the specimen to provide as intimate contact as possible with the dielectric material. The measurements were made at about 25°C with a dose rate of 0.014 r/min from a small Co^{60} source, using an applied potential of 90 v. Data are tabulated and results are compared with previous measurements by others. (C.H.)

1921

PROCESS FOR FORMATION OF BUBBLES PRODUCED IN IRRADIATED URANIUM. Fumio Hashimoto (Atomic Energy Lab., Kawasaki Dock Yard Co., Ltd., Japan). J. Atomic Energy Soc. Japan 2, 518-22(1960) Sept. (In Japanese)

It is well known that the swelling of irradiated uranium is due to bubbles. The behavior of vacancies and fission gas atoms in the uranium lattice is studied, and it is shown that the processes for bubble formation depend on the concentration of trapping sites and the irradiation temperature. As a result of calculation, the swelling of irradiated uranium is least if the concentration of the trapping sites is greater than about 5×10^{-8}. (auth)

1922

ELECTRON SPIN RESONANCE IN NEUTRON-IRRADIATED CALCITE. J. C. Kemp (Univ. of California, Berkeley). J. Chem. Phys. 33, 1269-70(1960) Oct.

Electron spin resonance spectra were studied for pure single calcite crystals irradiated with fast neutrons in which extremely narrow lines (width ~0.1 gauss) with thermal relaxation times at liquid helium temperatures of several seconds were observed. Crystals irradiated with doses of 10^{17}, 10^{18}, and 10^{19} fast neutrons became brownish in color, and the main features of the spectrum of the sample irradiated with 10^{17} neutrons were studied at 8700 Mc and 77°K; whereas H_0 was rotated in a plane normal to the c axis. The implications of the observations are discussed. (D.L.C.)

1923

IMPURITY TRAPPED INTERSTITIALS AND THE LOW TEMPERATURE ANNEALING STAGES OF IRRADIATED COPPER. Ryukiti R. Hasiguti (Univ. of Tokyo). J. Phys. Soc. Japan 15, 1807-14(1960) Oct. (In English)

A semiempirical method was developed to evaluate interaction energies of close impurity-atom-interstitial pairs. It was found that an undersize impurity atom provides a deep trap for an interstitial, while an oversize impurity atom furnishes to an interstitial several shallow traps with different interaction energies. These results were applied to the annealing temperature problem of irradiated copper. Stage II was interpreted as due to the liberations and annihilations of several kinds of shallow-trapped interstitials, and stage III was explained as due to the liberations and annihilations of deep-trapped interstitials. (auth)

1924

X-RAY STUDY OF NEUTRON IRRADIATED BARITE ($BaSO_4$). J. M. Luthra and V. M. Padmanabhan (Atomic Energy Establishment, Trombay, India). J. Sci. Ind. Research (India) 19B, 406-7(1960) Oct. (In English)

Studies on the x-ray line broadening of the neutron irradiated barite crystal revealed that the broadening is due to strain in the lattice rather than to particle size. The imperfections are found to be along (001) planes separated vertically by a distance of 1100A. (auth)

1925

RADIATION DAMAGE IN METALS. Donald Peckner (Westinghouse Electric Corp., [Pittsburgh]). Materials in Design Eng. 51, No. 1, 89-93(1960) Jan.

The effects of the various types of radiation on structural materials are discussed. Fast-neutron bombardment has the greatest effect on the physical and mechanical properties of the materials. The effects of radiation on metals were found to be greatest in annealed materials and decreased in magnitude as lattice defects were introduced by cold work or heat-treatment. Experimental data showed that radioinduced changes can be removed almost completely by "annealing out" defects introduced by neutron bombardment. Radiation effects on yield strength, tensile strength, fatigue, creep, transition temperature, and elastic properties are discussed. It was found that the effects of radiation damage could be nearly eliminated by raising the temperature to which the component is exposed. (M.C.G.)

1926

HOW RADIATION AFFECTS ENGINEERING MATERIALS. Richard E. Bowman (Battelle Memorial Inst., Columbus, Ohio). Materials in Design Eng. 52, No. 1, 119-34(1960) July.

A summary is given of the ways in which radiation affects structural materials, inorganic nonmetallics, elastomers, plastics, and organic fluids. Most radiation effects, transient or permanent, are caused by γ rays and neutrons. Structural materials are not so susceptible to radiation damage as the other materials. Radiation effects can be minimized by decreasing radiation dose, or increasing temperatures during irradiation. The damage can be repaired or removed by annealing. The effects of neutron irradiation on the tensile properties of metals are summarized in tables. Inorganic materials show many changes in physical and mechanical properties. The inorganic materials studied include graphite, carbides, glass, ceramics, and related materials. Elastomers vary widely in radiation resistance owing to the use of filters, additives, and radiation-resistant resins. In general, the radiation resistance of plastics was found to be equal to, or better than, that of elastomers. Composition adjustment in organic fluids was used to increase radiation resistance. (M.C.G.)

1927

EFFECTS OF IRRADIATION IN REACTORS ON METALLIC URANIUM. P. Bussy. Metaux (Corrosion–Inds.) No. 413, 24-39(1960) Jan. (In French)

As an introduction to the experimental study, some basic nuclear physics is reviewed, such as the nature of radiation in a reactor, neutron scattering by collisions, rate of burn-up, and fast ion collisions. The experiments dealt with growth of uranium under radiation, effects of irradiation temperature on monocrystalline samples, experiments with polycrystalline samples, and surface deformation. The theories or mechanisms proposed to explain the radiation effects on uranium are grouped under either the thermal spike or the point defect. The applicability of each type of mechanism to the experimental results obtained is discussed. (T.R.H.)

1928

SMALL-ANGLE X-RAY SCATTERING BY PILE-IRRADIATED GRAPHITE. W. T. Eeles (Berkeley Nuclear Labs., Gloucestershire, Eng.). Nature 188, 287-9(1960) Oct. 22.

Small-angle x-ray scattering of intensity much greater than that found with unirradiated graphite was observed with specimens of polycrystalline artificial graphite of reactor grade heavily irradiated at temperatures in the vicinity of 150°C. The intensity distributions were not sufficiently accurate to give any reliable indication of the shape of the scattering centers. However, it appeared likely that in irradiated graphite there were disk-like aggregates of interstitial atoms, sandwiched between the graphite layers and formed by clustering of the atoms displaced by neutron bombardment. (M.C.G.)

1929

HEAT TREATMENT OF IRRADIATED POLYPROPYLENE. Hiroshi Sobue and Yoshio Tazima (Univ. of Tokyo). Nature 188, 315-16(1960) Oct. 22.

The delayed cross-linking effect in irradiation of polymers was demonstrated by heat-treatment of preirradiated isostatic polypropylene. It was found that many trapped radicals produced during irradiation, which were stable at room temperature, could contribute to delayed cross-linking on annealing the polymer after irradiation at 25°C, and a big increase in gel content was observed. Materials irradiated at 180°C gave no gel content for high dosage, indicating that in the molten state degradation of the molecular chain was predominant. (M.C.G.)

1930

EFFECTS OF RADIATION OF PROPERTIES OF TiAl. E. M. Grala and J. B. McAndrew (Illinois Inst. of Tech., Chicago). p.229-43 of "Mechanical Properties of Intermetallic Compounds." J. H. Westbrook, ed. A Symposium held during the 115th Meeting of the Electrochemical Society at Philadelphia, Pennsylvania, May 3-7, 1959. New York, John Wiley & Sons, Inc., 1960.

The effects of neutron irradiation on the properties of TiAl were investigated to determine whether such irradiation results in disordering the TiAl phase and consequently changing the structure from face-centered tetragonal to cubic, which is expected to have superior forming properties. A special container with specimen bars was irradiated to 10^{20} nvt levels at an equilibrium temperature of 225°C in the CP-5 reactor; the ratio of thermal to epithermal neutrons was estimated to be 8.5 to 1. After irradiation, the specimens and their controls were annealed at 225°C for two months, and then their properties were measured. The average changes were Δ electric resistivity = + 7.55%, Δ hardness = + 9.6%, Δ density = none, and impact strength = −48%. No difference was noted between unannealed and annealed controls. A study was made on the kinetics of recovery in the radioinduced hardness of samples by holding at several high temperatures and measuring the time necessary for 50% recovery; the data give an activation energy for hardness recovery of 46 kcal/mole, a low value. The conclusions expressed are that it is very unlikely that much disordering of the crystal structure took place and that the observed property changes were due to general radiation damage. (D.L.C.)

1931

IRRADIATION EFFECTS ON THERMOELECTRIC MATERIALS. J. C. Danko, G. R. Kilp, and P. V. Mitchell (Westinghouse Electric Corp., Pittsburgh). Paper No. 1276-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 8p.

The prime subject of a research and development program on a thermoelectric nuclear fuel element was $Li_xNi_{1-x}O$. In-pile measurements of the Seebeck coefficient and electrical resistivity were made at reactor ambient temperatures and elevated temperatures. In addition, preirradiation and postirradiation measurements of the Seebeck coefficient, electrical resistivity, and thermal

conductivity were performed. The following compositions were tested: $Li_{0.013}Ni_{0.987}O$ and $Li_{0.05}Ni_{0.95}O$. Postirradiation measurements on $Li_{0.013}Ni_{0.987}O$ samples after exposure to a total integrated thermal neutron flux of 1.4×10^{19} revealed that the electrical resistivity returned to the preirradiation value; the Seebeck coefficient increased slightly; and the thermal conductivity remained essentially unchanged. In-pile measurements of the Seebeck coefficient and electrical resistivity of $Li_{0.05}Ni_{0.95}O$ at 464°C and up to 8×10^{18} nvt (thermal) did not show much variation from out-of-pile values. (auth)

1932
International Atomic Energy Agency, Vienna.
THE BEHAVIOUR OF REACTOR COMPONENTS UNDER IRRADIATION. L. Grainger. Review Series. Developments in the Peaceful Applications of Nuclear Energy, No. 6. 1960. 62p. $1.00.

The general nature of irradiation effects that are important to reactor components is discussed. The specific effects of irradiation on some of the most important materials are described; these materials include uranium metal, UO_2, UC, graphite, and structural metals, including steels and beryllium. The performance of certain key components under the influence of irradiation is discussed and some opinions are expressed regarding the industrial exploitation of atomic energy. Fuel elements are considered at greatest length; the limitations and development potential are assessed for fuel elements of various categories, including the Calder Hall type, those based on UO_2, and fuel elements for fast reactors and high-temperature gas-cooled reactors. In all these cases, future development seems promising. The behavior of structural components such as steel pressure vessels and graphite moderators is considered. It is concluded that better understanding will alleviate some of the current problems. (auth)

1933
IMPROVEMENTS RELATING TO THE MANUFACTURE OF EXPANDED POLYMERISATION PRODUCTS. Solomon Harris Pinner (to T. I. (Group Services) Ltd.). British Patent 850,965. Oct. 12, 1960.

Methods of producing expanded polymerization products, especially from polyethylene, may be improved by subjecting the material to irradiation after the incorporation of the blowing agent but before expansion by heat. In this way, the average pore size of the foamed product is decreased, rupture of cell walls is prevented, water resistance is increased, and compression characteristics are improved. Blowing agents with decomposition temperatures above the melting point of the normal unirradiated material may be used. The latter advantage is an important one since blowing agents may then be used, which are very stable during the milling process. This method may be applied to other thermoplastics capable of radio-induced crosslinking. Four examples of the method are given in which polyethylene (Alkathene 2 and Marlex) is used with p,p-oxybisbenzenesulfonhydrazide (Genitron OB), azodicarbonamide (Genitron AC), and dinitrosopentamethylenetetramine (Vulcacel BN) as blowing agents. (D.L.C.)

PHYSICS

General and Miscellaneous

1934 60-GC-127
General Electric Co. Research Lab., Schenectady, N. Y.
NUCLEAR MAGNETIC RESONANCE STUDY OF METALS AND ALLOYS. Final Report [for] May 1, 1960 to July 31, 1960. M. B. Webb. Aug. 10, 1960. 26p. Contract Nonr-2615(00).

The Al^{27} nuclear resonance in AlZn and AlMg was studied as a function of composition, temperature, and applied magnetic field. At temperatures where the dipolar width is motionally narrowed but where the quadrupole splitting of the satellite lines is not, the second order quadrupole shift of the central transition is readily measurable. The measured gradients are essentially the same in AlMg and AlZn alloys consistent with the suggestion that the gradients arise from the electronic charge distribution about the solute and not from strain effects. The average gradients are of the order of 1×10^{23} cm^{-3}. The Al Knight shift in the alloys is equal to that in pure aluminum to within the experimental uncertainty. The results are compared with the previous experiments of Rowland and the theory of Blandin and Friedel. (auth)

1935 AD-235332
Purdue Univ., Lafayette, Ind.
SEMICONDUCTOR RESEARCH QUARTERLY REPORT NO. 14 [FOR] NOVEMBER 1, 1959 TO JANUARY 31, 1960. 70p. Contract DA-36-039-sc-71131.

Activities in research programs concerned with semiconductor electric and optical properties, irradiation effects, low-temperature studies, and theoretical aspects are summarized. (auth)

1936 AFCRC-TR-59-360
Air Force Cambridge Research Center. Electronic Material Sciences Lab., Bedford, Mass.
ELECTRONIC MATERIAL SCIENCES LABORATORY STATUS REPORT. Dec. 1959. 197p. (AD-233841).

The following studies are briefly reported: research on thermofusion crystal growth; Al_2O_3 single crystal growth; structure refinement of lutetium iron garnet; magnetic resonance research; semiconductor research; purification of Cr, Sn, Pb, Zn, and Mg; Si diffusion studies; nucleonics and vacuum electronics; pyrogenics; and gaseous electronics and plasma physics. (J.R.D.)

1937 GA-848
General Atomic Div., General Dynamics Corp., San Diego, Calif.
THE CONTINUOUS OPACITY AND EQUATIONS OF STATE OF LIGHT ELEMENTS AT LOW DENSITIES. Jeremy Bernstein and Freeman J. Dyson. July 13, 1959. 35p. Project No. 52. Contract AF19(600)-1812.

An approximate method for computing the opacity of light elements at low densities ($\sim 10^{-3}$ g/cm^3) in the Rydberg temperature range is described. Based on this method, a code was developed for which results for H, He, Li, Be, B, C, N, O, and F at various temperatures and densities are reported. (C.J.G.)

1938 GA-1641
General Atomic Div., General Dynamics Corp., San Diego, Calif.
DIRECT CONVERSION OF NUCLEAR HEAT TO ELECTRICITY. R. C. Howard. Sept. 1, 1960. 19p.

The methods of incorporating two direct-conversion principles (the thermionic and the thermoelectric) into reactor systems are described. Space, marine, and land-based applications of direct-conversion systems as compact, reliable sources of power are discussed. (W.D.M.)

1939 GEAP-3373
General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.
THE DETERMINATION OF URANIUM BURNUP IN MWD/

TON. B. F. Rider, J. L. Russell, Jr., D. W. Harris, and J. P. Peterson, Jr. Mar. 17, 1960. 67p. (R60APE5).

The mass-spectrometric and radiochemical methods for the determination of burn-up in nuclear fuel are compared for reliability in the range of 5000 to 15,000 Mwd/ton. Neither appears to be clearly superior to the other. Each appears to have an uncertainty of approximately 6 to 8%. It is concluded that both methods of analysis should be employed where reliability is of great concern. Agreement between both methods is the best possible indication of reliable results. (auth)

1940 LMSD-703084
Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.
HIGH-SPECTRUM REACTORS AS POSSIBLE THERMIONIC PRIMARY HEAT SOURCES. John E. Cobb. Sept. 1960. 50p. OTS.

A one-space dimensional, multigroup, multiregion analysis was performed on a series of fast and semifast neutron spectrum refractory reactor types. Diffusion theory was used with transport corrections applied in the description of the neutron-transport process. The boundary conditions and selection of the energy groups used in the analysis gave a very good approximation to criticality for the types of reactors studied. Three primary reactor types were investigated pending final heat-transfer studies to determine the type which can best supply primary power to the thermionic units at the best mass ratio. The three types studied were bare critical, reflected, and internally moderated and externally reflected. (auth)

1941 MND-P-2354
Martin Co. Nuclear Div., Baltimore.
NUCLEAR 1.0-WATT POWER SUPPLY FOR SPACE APPLICATION. Final Report [for] period covered: October 19, 1959–June 30, 1960. D. J. Knighton. June 1960. 54p. Contract AT(30-3)-217. OTS.

Activities in a program to analyze and design a 1-watt(e) power-supply system consisting of a radioisotope-powered generator and a static voltage converter are described. The preliminary generator design was used to manufacture a breadboard device for testing, and the design and analysis of the converter were completed. Revisions of the preliminary generator design are also discussed. (J.R.D.)

1942 MND-P-2372
Martin Co. Nuclear Div., Baltimore.
DEVELOPMENT OF A THERMOELECTRIC OPTIMIZATION CODE FOR THE IBM-709. T. S. Bustard and W. C. Lyon. July 1960. 142p. Contract AT(30-3)-217. OTS.

The Thermoelement Optimization Method is an IBM 709 FORTRAN code which will, by means of automatic computation, perform a thermoelement analysis. Given hot and cold junction temperatures, thermoelectric material properties, and desired electrical output characteristics, it calculates the number and size of the thermoelements, the required thermal input, thermoelectric efficiency, and the electrical characteristics of the generator. Hot-junction contact resistance and Thomson effects may be taken into account or neglected, as desired. The basic calculation technique, as built into the code, may be briefly described as an adjustment of the thermal and electrical paths through the thermoelectric material under consideration in order to attain maximum material efficiency. The differential equation accurately describing the thermoelectric effects was obtained as an energy balance over an incremental segment of an element, and its solution was determined by a numerical technique. Temperature-dependent properties are therefore considered as variables rather than treated as over-all averages, which is the usual calculation technique. (auth)

1943 MND-P-2374
Martin Co. Nuclear Div., Baltimore.
13-WATT CURIUM-FUELED THERMOELECTRIC GENERATOR FOR HARD LUNAR IMPACT MISSION. Final Report–Subtask 5.8. Justin L. Bloom. Aug. 1960. 57p. Contract AT(30-3)-217. OTS.

Results of a conceptual design study for a curium powered thermoelectric generator of minimum size and weight which is capable of sustaining hard impact is presented. The generator produces a minimum of 13 watts of d-c power at 3 volts, and weighs 6.2 pounds excluding shielding. (J.R.D.)

1944 MND-P-2413
Martin Co. Nuclear Div., Baltimore.
BIBLIOGRAPHY OF SNAP REPORTS. Aug. 1960. 9p. Contract AT(30-3)-217. OTS.

A listing is presented of documents, films, slides, and those items which were formally produced for utilization by the AEC concerning the SNAP project. (J.R.D.)

1945 MND-P-3011
Martin Co. Nuclear Div., Baltimore.
SNAP PROGRAMS. Quarterly Progress Report No. 3 [for] April 1 through June 30, 1960. 162p. Contract AT(30-3)-217. OTS.

Design studies were made for the cooling, shielding, and electrical-control support systems required for the testing of the isotope-fueled 125-w generator in a hot-cell facility. A ceric oxide fuel containing 10 wt. % SiC exhibited suitable burn-up characteristics in simulated postorbital re-entry heating conditions. Inconel X was selected as the fuel-containment material. Negative pitch angle injections were evaluated for the injection-stage flight vehicle. The second electrically heated 125-w generator was assembled and prepared for checkout. A successful reproducible process for bonding the p element was developed in which GeTe was furnace melted into an iron shoe and a spring-loaded element was bonded to the shoe in an induction furnace. The p element contact resistance was 0.1 milliohm. The maximum output on the first generator was measured as 78.2 w. Measurements were stopped when power output deteriorated to 28.8 w. An inspection showed that oxidation due to insufficient reducing atmosphere at the hot junction contacts was the cause. Parametric thermoelectric generator performance tests were conducted in which the internal gas pressure was varied from 0 to 1.5 atm. and the external pressure was either 1 atm. or a vacuum. The fabrication, operation, and performance of cesium diodes were studied. The effect of a molybdenum powder film on heat transfer when placed in a molybdenum–tungsten interface was determined. In development studies on a low-power thermionic generator, cathode and sapphire-support creep tests were conducted up to 500°C, at which temperature no creep was observed. The design of Generator 2A was completed. A heater was developed for the generators which is capable of simulating the power density of a Cm^{242} heat source. A titanium alloy, A-70, was found which possessed satisfactory properties for use as a lead-through at 1050°C. A method of electrically insulating the two stages of a generator was developed. Tests were performed which showed that no interaction takes place between Ce_2O_3 and molybdenum in an oxygen atmosphere at 1600°F. Methods for removing aluminum from a curium capsule by volatilizing in either bromine or chlorine gas were investigated. An analysis to determine the helium pressure build-up in aluminum-americium

capsules was conducted. Dose rates were determined for americium slugs before irradiation at distances from the slug surface up to 1 m. An evaluation of the effectiveness of the curium shipping cask was made. The power release by decay products of Pu^{236} and U^{232} was determined. Equations are presented concerning the reaction kinetics involved in the neutron irradiation of Am^{241} with the subsequent production of Cm^{242}. (For preceding period see MND-P-3010.) (C.J.G.)

1946 NAA-SR-Memo-5345

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

LEAST SQUARES DETERMINATION OF LATTICE PARAMETERS. I. R. Tannenbaum. June 2, 1960. 14p. OTS.

A least-squares method for determining crystal lattice parameters from indexed powder patterns is presented. A description of the FIB 1 code for use with the method is included. (J.R.D.)

1947 NASA-TN-D-465

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

THE MAGNETIC FIELD OF A FINITE SOLENOID. Edmund E. Callaghan and Stephen H. Maslen. Oct. 1960. 24p. OTS.

The axial and radial fields at any point inside or outside a finite solenoid are derived in terms of tabulated elliptic junctions. Dimensionless field plots are presented for a wide range of solenoid lengths. (auth)

1948 NASA-TR-R-50

National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPROXIMATIONS FOR THE THERMODYNAMIC AND TRANSPORT PROPERTIES OF HIGH-TEMPERATURE AIR. C. Frederick Hansen. 1959. GPO.

Supersedes NACA-TN-4150.

Approximations are presented for the thermodynamic and transport properties of high-temperature air. Compressibility, enthalpy, entropy, specific heats, speed of sound, coefficients of viscosity and thermal conductivity, and the Prandtl number are tabulated for 500 to 15,000°K over a range of pressures from 0.0001 to 100 atm. (auth)

1949 NOTS-TP-2377

Naval Ordnance Test Station, Inyokern (China Lake), Calif.

BIBLIOGRAPHY OF ELECTRO-OPTICAL AND MAGNETO-OPTICAL PHENOMENA AND THEIR APPLICATIONS. J. M. Ruhge and D. Green. Dec. 1959. 58p. (AD-235612).

A bibliography containing entries taken from the Industrial Arts Index and from the book and technical report files of the NOTS Technical Library is presented. References are given on: the Kerr electrooptical effect; magneto-optical effects; applications of piezoelectric crystals, iconoscopes, orthicons, and vidicons; image converter tubes; high-speed shutters; and the electroluminescent effect and its applications. The bibliography is current as of February 1959. (auth)

1950 NP-9166

India. Dept. of Atomic Energy. Physics Advisory Committee, Bombay.

PROCEEDINGS OF THE SYMPOSIUM ON LOW ENERGY NUCLEAR PHYSICS, CALCUTTA, INDIA, FEBRUARY 19-21, 1959. 351p.

Forty-three papers are given, some of a review nature, which were presented at the Third Annual Symposium on Low Energy Physics held in Calcutta on Feb. 19 to 21, 1959. The subjects are parity nonconservation, nuclear models, and nuclear instruments. Separate abstracts were prepared for 29 papers; 11 were previously abstracted in NSA. (D.L.C.)

1951 NP-9251

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

EFFECTS OF ELECTROMAGNETIC FIELDS UPON INSTRUMENTATION COMPONENTS AND SYSTEMS. George R. Evans. July 27, 1960. 55p. (SB-60-27).

This bibliography includes 180 references from reports and published literature on the effects of electromagnetic fields on instrumentation components and systems. (J.R.D.)

1952 NP-9261

Scripps Institution of Oceanography, La Jolla, Calif.

ON THE MOMENTUM DISTRIBUTION OF AN INTERACTING ELECTRON GAS. Technical Report No. 2. E. Daniel and S. H. Vosko. [1960]. 15p. Project NR 017-630. Contract NONR-2216 (11).

The momentum distribution of an interacting electron gas at zero temperature is studied in the high-density region. Numerical computations are made for the graphs corresponding to the excitation of pairs, which are known to be equivalent to the random phase approximation of Bohm and Pines. Exchange graphs are discussed. The numerical results, extrapolated to actual electronic densities in metals, show that a large discontinuity in the momentum distribution still remains at the Fermi level. (auth)

1953 NP-9299

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati.

XM-731 PLASMA ENGINE RESEARCH AND DEVELOPMENT PROGRAM. Second Quarterly Progress Report, September 1960. Boyd W. Harned. 22p. Contract AF33(616)-7176.

The experimental and theoretical programs for investigating the operation of the continuous-flow crossed-field MHD plasma accelerator were extended with very encouraging results. The goal of attaining high electron current flow at the cathode of the accelerator was reached preliminarily, and an accelerator model was developed and satisfactorily operated. Thus, the feasibility of the proposed concept was demonstrated through the development of a suitable design. Three models of the accelerator are discussed, although most of the experimental work was confined to a small model. Attention to the cathode thermionic emission comprised the major portion of the experimental test program. A new accelerator test facility was constructed which allows a greater flexibility of operation and instrumentation installation. A means is discussed for the measurement of plasma velocity by the Doppler shift principle. The Hall and end effect problem is discussed, and current distributions at the accelerator ends are shown for the special case of uniform magnetic field. The problem of extension of the calculations to varying magnetic field is mentioned. The reduction of accelerator efficiency as a result of the Hall effect is shown in graphical form. (For preceding period see NP-9022.) (auth)

1954 NP-9316

Columbia Univ., New York. Columbia Radiation Lab.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Quarterly Progress Report No. 2 [for] March 16, 1960 through June 15, 1960. P. Kusch. June 15, 1960. 48p. Contract DA-36-039-SC-78330. (CU-6-60-SC-78330-Phys.).

A large part of the work of the laboratory is concerned with the investigation of those basic physical properties of matters of interest in the design of masers; with the design

of masers to meet a variety of needs; and with the application of masers to the study of various physical and astronomic problems. Work in each of these aspects of maser research is described. The design of a radiotelescope to be utilized in a measurement of the oxygen content of the upper atmosphere and not using a maser amplifier is discussed. Various problems in the determination of atomic hyperfine structures are under investigation and the status of the work is reported. The present emphasis lies in atomic states other than the ground state and in reasonably short-lived radioactive isotopes. Studies in various problems of chemical physics, principally related to the properties of the gases evaporated from substances that are ordinarily solids are described. (For preceding period see NP-8706.) (auth)

1955 TID-6503

Kansas. Univ., Lawrence. Nuclear Physics Lab.
PROGRESS REPORT FOR 1959–1960. 80p. Project No. 6. Contract AT(11-1)-83. OTS.

The investigation of the properties of the 9.16-Mev state in N^{14} was continued with a computer analysis of the angular correlation and distribution. The magnetic particle analyzer was used to study the elastic scattering of protons on Mg^{25} at various resonances in the vicinity of 1 Mev. The cross sections for the well-known resonances at 0.986, 1.084, and 1.148 Mev were observed at lab angles of 90, 109.9, 125.3, and 140.0°. The excitation function was obtained for the capture reaction $Mg^{25}(p,\gamma)$. Concurrent with the capture work on Mg^{25}, the reaction $Al^{27}(p,\gamma)$ was studied in some detail. A considerable amount of time was spent in studying the behavior of the scintillation spectrometers to γ rays of various energies. The pulse shapes of γ rays between 1 and 16 Mev were studied as a function of crystal mounting, source to crystal distance, collimation, and various other factors. An attempt was made to compare the observed shapes to those theoretically predicted. The possibility of improving the methods of spectra analysis was considered. Considerable time was invested in writing and testing several general programs for the IBM-650 to help in the angular correlation and distribution work. (W.D.M.)

1956 TID-6632

New York Univ., New York.
THERMAL STRESSES IN RECTANGULAR PLATES. Structural Memo No. 49. H. Becker. Aug. 3, 1960. 9p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contracts AF33(600)-38062 and AT(11-1)-171. Subcontract No. AT-136. (XDC-60-8-82). OTS.

A technical status report relating to the project on the photothermoelastic investigation of rectangular plates is presented. Experiments used to verify analytic procedures developed for determining thermal stresses are described along with procedures developed for determining the thermal stresses by photoelastic methods. Parabolic gradients are used in the investigation. These techniques have already been applied for determining by photoelastic methods the thermal stresses in hexagonal sections with central circular holes. (auth)

1957 TID-6645

General Electric Co. General Engineering Lab., Schenectady, N. Y.
EFFECT OF CREEP ON STRESSES IN CYLINDRICAL SHELLS STRUCTURAL MEMO NO. 51. H. Poritsky. Aug. 3, 1960. 18p. For General Electric Co. Aircraft Nuclear Propulsion Dept. Contract AF33(600)-38062 and AT(11-1)-171. (XDC-60-8-119). OTS.

Equations for expressing the effect of creep under stress distribution in stressed cylindrical shells are presented. (auth)

1958 TID-6676

Los Alamos Scientific Lab., N. Mex.
INTERACTING FERMI SYSTEMS. A series of seminars given at the Los Alamos Scientific Laboratory, Summer, 1960, by Professor Robert Brout of Cornell University. Notes by Kent Harrison. 94p. OTS.

The study of interacting Fermi systems is to a considerable extent concerned with the concept of the "quasi-particle," as presented by Landau. Topics discussed at length include Hartree-Fock theory, f as forward scattering amplitude, effective mass, specific heat of an ideal Fermi gas, compressibility, zero sound, magnetic susceptibility, quasi-particle, theory, and superconductivity. (W.D.M.)

1959 AEC-tr-4271

THE THERMODYNAMICS OF THE SUPERSTATE. V. K. Semenchenko. Translated from Zhur. Fiz. Khim. 33, 1440-5(1959). 8p. JCL or LC.

The thermodynamic similarities between superconductivity and superfluidity are examined. It was previously shown that conditions for thermodynamic stability govern the identity of superstates. These aspects are discussed and enlarged for the case of three variables. A discussion of other superstates which may exist but have not been discovered is included. (J.R.D.)

1960 CEA-tr-R-908

SCINTILLATIONS $-\gamma$-FONCTION DE LA TEMPÉRATURE DANS LES CRISTAUX DE L'IODURE DE CÉSIUM ACTIVÉS PAR LE THALLIUM. γ Scintillations as a Function of Temperature in Cesium Iodide Crystals Activated by Thallium). S. N. Komnik, V. I. Startsev, Yu. (Iu.) A. Tsirlin. Translated into French by B. de Trezvinsky from Optika i Spektroskopiya 4, 411-12(1958). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 8610.

1961 CEA-tr-R-927

DÉTERMINATION DES CORRECTIONS PENDANT LES MESURES DE L'ACTIVITÉ DES SOURCES-β. (Determination of Corrections During Measurement of the Activity of β Sources). G. G. Aref'ev (Arefiev). Translated into French by B. de Trezvinsky from Pribory i Tekh. Ekspt. No. 5, 123-4(1959). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 8585.

1962 IG-Inf.-Ser.-86

THE DETERMINATION OF GRAIN SIZE AND DIFFUSION CONSTANTS BY MEANS OF THE EMANATION POWER (THE THEORY OF THE EMANATION METHOD). F. Flugge and K. E. Zimens. Translated by R. Presser (U.K.A.E.A., Risley) from Z. physik. Chem. (Leipzig) 42B, 179-220(1939). 36p.

The relations between the radiation count, grain size or surface, and diffusion constant of the radioactivity of a substance were derived. The radiation count of a single grain is discussed relative to the effects of recoil and diffusion. The influence of coalescence of several grains in a powder or similar substance on the radiation count of a substance is discussed. The calculation of the variation in radiation count with temperature, due to change of the diffusion constant for a distorted lattice, was made. (C.J.G.)

1963 IGRL-T/C-74

SOME NEW TYPE OF ELECTRIC ARC. PART 4. ARCS WITH AN ELECTRODE CONSISTING OF A CARBON DISC ROTATING AT HIGH SPEED, PARTIALLY IMMERSED IN THE SOLUTION TO BE EXAMINED and PART 5. ARCS WITH AN ELECTRODE CONSISTING OF ONE OR MORE METAL DISCS ROTATING AT HIGH SPEED. M. Pierucci

and L. Barbanti-Silva. Translated by E. G. Peters from Nuovo cimento (8) 17, 275-282(1940). 14p.

An arc is described in which a thin, large-diameter carbon disc, rotating at high speed and skimming the surface of the solution to be examined, acts as an electrode. Unlike ordinary arcs, the different zones do not envelop each other, but are spread out fan-wise in a sort of luminous gaseous sheet, with a filiform (thread-like) base, which may be cathodic or anodic. The various phenomena of inhibition and excitation observed, which gradually change with passage from one zone of the arc to another, are clearly visible separately, and no longer hinder spectroscopic analysis. In place of the carbon disc, there can be substituted a wheel made up of one or more very thin, coaxial discs, of equal diameter and pressed together, which may be made of various metals. The spectroscopic results allow interesting applications to be predicted in the analysis of alloys. (auth)

1964 NP-tr-477

AN EXPERIMENTAL STUDY OF THE THERMAL CONDUCTIVITY OF HELIUM. Translated from Teploenergetika 5, No. 10, 61-5(1958). 7p. JCL or LC.

The thermal conductivity of helium is reported at 100, 200, 300, 400, and 500 kg/cm^2. An equation is proposed which describes the thermal conductivity at temperatures below 800°C. (J.R.D.)

1965 NP-tr-493

GAS CONVECTION IN ULTRACENTRIFUGES AND ITS SIGNIFICANCE IN THE DEVELOPMENT OF GAS CENTRIFUGATION. H. Martin. Translated by Kurt H. Quasebarth (Univ. of Virginia) from Chem.-Ingr.-Tech. 31, 73-9(1959). 27p.

Issued as Univ. of Virginia Research Laboratories for the Engineering Sciences Report No. EP-4422-111-60U.

The properties of radial, axial, and turbulent convection in gas centrifuge rotors are reviewed and it is shown how the methods of gas centrifugation have been influenced in time by the increasing understanding of these kinds of flow. A report is given for the first time on a forerunner of the present countercurrent centrifuge and on the results and course of the Institute's study in the field of gas centrifugation. (auth)

1966 SCL-T-332

FORCED VIBRATIONS OF A SYSTEM WITH ONE DEGREE OF FREEDOM IN THE PRESENCE OF DRY FRICTION AND WITH AN OPERATING ARBITRARY EXCITING FORCE. (Vynuzhdennye Kolebania Sistemy s Odnoy Stepen'u Svobody pri Nalichii Sukhogo Trenia i pri Proizvol'noi Vozmushchayushchey Sile). A. M. Strekis. Translated by Marcel I. Weinreich (Sandia Corp.) from Latvijas P. S. R. Zinatnu Akad. Tehnisko Zinatnu Nodala. Sbornik Statei. No. 4, 95-121(1956). 37p. JCL or LC.

A method of determining stationary vibrations in the presence of dry friction is presented. Methods are used which were applied in investigations of the nonstationary vibrational processes in the absence of friction and in the case of viscous friction in the presence of an arbitrary operating exciting force. It is noted that this method may be applied to other types of exciting forces. (J.R.D.)

1967 UCRL-Trans-570(L)

PRESENT STATUS OF PHOTOELECTRIC RESEARCH. Werner Kluge. Translated from Z. angew. Phys. 7, 302-11 (1955). 20p. JCL.

The status of photoelectric research up to 1954 is discussed relative to quantum yield in metals, oxide layers on photocathode tubes, and photoelectric effect in colored alkali halide layers, semiconductors, and germanium crystals. 122 references. (C.J.G.)

1968

DEVIATIONS FROM EQUIPARTITION OF ENERGY WITH NONQUADRATIC HAMILTONIAN. Anton Peterlin (Univ. of Ljubljana, Yugoslavia). Am. J. Phys. 28, 716-18(1960) Nov.

If the Hamiltonian contains nonquadratic terms, the energy contribution per particle and degree of freedom deviates from $\frac{1}{2}kT$ (classical approximation). A very simple case which can be easily treated is that of a particle in a sinusoidal potential field. Energy, free energy, and molar heat are calculated as an example of the resulting deviations from equipartition. (auth)

1969

THE ACTION OPTION AND A FEYNMAN QUANTIZATION OF SPINOR FIELDS IN TERMS OF ORDINARY C-NUMBERS. John R. Klauder (Princeton Univ., N. J.). Ann. Phys. (N. Y.) 11, 123-68(1960) Oct.

The Feynman sum represents a convenient formulation of quantum mechanics for Bose fields; but to secure a similar formulation applicable to Fermion fields, it was necessary to use anticommuting c-number field histories to insure the anticommutivity of the quantum field operators. A method is presented to sum over histories for spinor fields that employs the familiar classical c-number expression for the action, predicts anticommutation rules and Fermi statistics, and retains the invariance of the theory under a change in phase of the complex Ψ field. The Feynman procedure demands a numerical action value for histories outside the domain for which the action integral was intended (e.g., for histories that are discontinuous with respect to space or time). One is therefore presented with an action option, (i.e., the action value for such unruly histories may be defined in various ways). Depending on the choice made, the resulting quantum theory can be made to manifest either Bose or Fermi statistics. This ambiguity is inherent in the formalism itself. However, the proper choice to extend the classical information is most readily determined by constructing the sum over histories by a summation over multiple products of matrix elements of the unitary operator, which advances the state an infinitesimal time. This summation need not be limited to the familiar discrete basis vectors; instead a generalized representation can be employed which involves, for each Fermion degree of freedom, continuously many nonindependent vectors. When a suitable parameterization is chosen for this overcomplete family of states, the multiple product of matrix elements for a given history reduces to the exponential of the appropriate action functional evaluated for that history. A unified formulation of both statistics for the Schrödinger field is presented which includes a detailed account of the necessary properties of the overcomplete family of states and a derivation of the functional measure for Fermion fields. The propagator and a functional expression for the ground state of the neutrino field are presented as applications of the method to relativistic spinor fields. (auth)

1970

THE INHOMOGENEOUS WAVE EQUATION IN LOCAL RELATIVISTIC QUANTUM FIELD THEORY. A. S. Wightman and H. Epstein (Princeton Univ., N. J.). Ann. Phys. (N. Y.) 11, 201-39(1960) Oct.

The equation $(\Box + m^2)\, u(x) = j(x)$, where $j(x)$ is a known local field, is solved for $u(x)$ in the form $u(x) = u^{(0)}(x) - \int \Delta_R(x-x')\, dx'\, j(x')$, where $u^{(0)}(x)$ is a free field. The possibility of choosing $u^{(0)}(x)$ so that $u(x)$ is local is studied by

considering vacuum expectation values containing j(x) and u(x). It is shown that in the case $j(x) = g\phi^2(x)$, $\phi(x)$ a free field, no $u^{(0)}(x)$ with the desired properties exists. The argument is generalized to the case of the equations of a neutral vector meson field, B, interacting with a spinor field, χ: $(\gamma^\mu \partial_\mu + m)\chi(x) = ie\,\gamma_\mu A^\mu(x)\Psi(x)$ and $\partial_\nu[\partial^\nu B_\mu - \partial_\mu B^\nu] + \kappa^2 B_\mu(x) = ie:\Psi^\dagger(x)\gamma_\mu\Psi(x):$. (auth)

1971

ON ASYMPTOTIC BEHAVIOR OF VACUUM EXPECTATION VALUES AT LARGE SPACE-LIKE SEPARATION. H. Araki (Princeton Univ., N. J.). Ann. Phys. (N. Y.) 11, 260-74(1960) Oct.

The asymptotic behavior of truncated vacuum expectation values at large space-like separation is studied. Truncated vacuum expectation values are values of products of field operators where the vacuum structure is subtracted out. It is shown under conventional assumptions of relativistic quantum field theory that the truncated vacuum expectation values at equal time tend to zero exponentially as the largest distance R of points tends to infinity with an exponent mR where m is the lowest mass and is assumed positive. It is shown that the truncated vacuum expectation values tend to zero in an averaged sense faster than any power of R if the points are divided into two groups and separated by large space-like distance R where the points need not lie on a common space-like hypersurface. (auth)

1972

PHOTOGRAPHIC OBSERVATIONS ON SHOCK WAVES IN LIQUIDS. H. G. David and A. H. Ewald (Commonwealth Scientific and Industrial Research Organization, Sydney). Australian J. Appl. Sci. 2, 317-20(1960) Sept.

A simple method of photographing shock waves in liquids and of observing the absorption spectra of solutions under the extreme pressure and temperature conditions of shock waves is described. A thin layer of argon, compressed and heated by a shock wave, is used as a high-intensity short-duration (0.2 μsec) flash source. The absorption spectra of the uranyl and neodymium ions are shown to be altered under these conditions. (auth)

1973

SUMMARIZED PROCEEDINGS OF A SYMPOSIUM ON THE GENERATION OF TEMPERATURES BELOW 1°K—LONDON, DECEMBER 1959. D. H. Parkinson. Brit. J. Appl. Phys. 11, 449-53(1960) Oct.

A one-day symposium on the methods of generating temperatures below 1°K was held at the Low-Temperature group of The Physical Society on 11 December, 1959. Six papers of a review nature were read and discussed. Attention was focused primarily on the techniques of adiabatic demagnetization and on the use of He^3; nevertheless, some of the more difficult techniques were reviewed with the more recently discovered properties of He^3. (auth)

1974

METRIC CONNECTION ASSOCIATED WITH A NON-SINGULAR ELECTROMAGNETIC FIELD. Xavier Hubaut. Bull. classe sci., Acad. roy. Belg. (5) 46, 143-7(1960). (In French)

A torsion tensor was associated with a nonsingular electromagnetic field in a space with Minkowski connections. The tensor constructed has only two irreducible components which are the gradients of two functions defined by the field. The Maxwell equations take, in this case, a very simple form. The case of a congruent connection is also examined. (tr-auth)

1975

VISCOSITY MEASUREMENTS IN LIQUID HELIUM II. C. B. Benson and A. C. Hollis Hallett (Univ. of Toronto). Can. J. Phys. 38, 1376-89(1960) Oct.

Measurements of the viscosity of liquid helium II were made using an oscillating sphere. This method avoids the necessity of a "corner" correction unavoidable when a circular disk is used, and therefore eliminates the uncertainty associated with such a correction. Calibration experiments showed the presence of a significant contribution to the observed damping of the oscillations which arose from the viscous drag of the gas surrounding the rod that connected the sphere with the torsion suspension fiber. This damping was calculated, and when applied to the results obtained in liquid helium II the values of the viscosity of the normal component, which were obtained, agree with those obtained by the rotating cylinder method within the combined experimental uncertainties. The assumed density of the normal fluid was that obtained from the velocity of second sound, and the most accurate thermal data available. (auth)

1976

STRUCTURE RESEARCH WITH THE AID OF NEUTRON DIFFRACTION. Siegfried Balke and Gernot Lutz (Universität, Munich). Chem.-Ingr.-Tech. 32, 651-8(1960) Oct. (In German)

The significance of neutron diffraction in research on physical properties of solids, particularly structural properties, is discussed. The theoretical basis of the exchange reaction of neutrons with material and the resulting possibilities for the application of neutron scattering in determination of crystal and magnetic structures are compared with x-ray scattering. A description of the neutron diffraction spectrometer installed at the Garching research reactor and some results are given. (auth)

1977

STUDY OF THE SENSITIVITY OF NUCLEAR EMULSIONS AT TEMPERATURES OF LIQUID NITROGEN AND HELIUM. Louis Avan and Claude Dubois (Faculté des Sciences, Clermont, France). Compt. rend. 251, 1280-2(1960) Sept. 26. (In French)

Nuclear emulsions of the Ilford K_0, C_2, G_5, and K_5 types, 200 μ thick, were placed in contact with a fine uranothorianite powder several seconds before their introduction to liquid nitrogen and helium temperatures. The emulsions were held for 2 hr at this temperature and developed by the dual temperature method. Only the G_5 emulsion retained a regular sensitivity at the temperature of liquid helium. A second series of emulsions was kept in liquid nitrogen for two weeks before being exposed to cosmic radiation. The G_5 emulsions were sensitive to the ionization minimum. (J.S.R.)

1978

A LIQUID LOOP AS A RADIATION SOURCE, WITH PARTICULAR REFERENCE TO RADIATION CHEMISTRY. PART II. Yu. S. Ryabukhin (Iu. S. Riabukhin) and A. Kh. Breger. Intern. J. Appl. Radiation and Isotopes 8, 72-81 (1960) July. (In English)

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 20646.

1979

THE THERMAL CONDUCTIVITY OF HEAVY WATER BETWEEN 75° AND 260°C AT PRESSURES UP TO 300 ATM. H. Ziebland and J. T. A. Burton (Explosives Research and Development Establishment, Waltham Abbey, Essex, Eng.). Intern. J. Heat and Mass Transfer 1, 242-54(1960) Aug. (In English)

The thermal conductivity of D_2O having an isotopic purity of 99.85% was measured with a vertical coaxial cylinder apparatus at pressures of 24 to 294 atm and temperatures of 75 to 260°C. The pressure range included the critical

pressure at 218 atm. Identical with the trend exhibited by water, the thermal conductivity of D_2O was found to increase with rising temperature to a shallow maximum near 110°C and to fall with a further rise in temperature. The influence of pressure on thermal conductivity was small, and at 75°C amounted to an increase of 0.77% for a pressure rise of 1 to 100 atm. This is similar to the values previously reported for natural water. Compared to natural water, the thermal conductivity of D_2O was always lower for the range under investigation. The ratio k_{H_2O}/k_{D_2O} increased almost linearly from 1.045 at 75°C to 1.134 at 260°C. (auth)

1980

INVESTIGATION OF THE INTERACTION OF FAST DEUTERIUM IONS WITH METALS. V. M. Gusev, M. I. Guseva, V. P. Vlasenko, and N. P. Elistratov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 689-93(1960) June. (In Russian)

Knowledge of the interaction of fast deuterons with a given metallic surface is of special interest in view of current studies on the preparation of hot plasma. Dispersion of the wall material leads to contamination of the plasma with heavy metal atoms resulting in energy losses. The dispersion coefficient of Cu was measured with 10- to 30-kev deuterons; the amount of D^+ taken up by Cu, Pd, and stainless steel was also studied. All measurements were performed in the chamber of a small electromagnetic separator using an ion source in which an oscillating arc discharge was maintained in a strong magnetic field. The duration of the tests ranged from 4 to 6 hr, calculating the amount of dispersed atoms from the weight loss of the target, determined to an accuracy of 2×10^{-5} g. The effect of secondary emission was eliminated by the strong magnetic field. By increasing the deuteron energy from 10 to 30 kev, the dispersion coefficient of Cu was decreased from 0.06 to 0.026 atom per ion, while elsewhere it was shown that the dispersion of Cu by Ar, Kr, Xe, and Cu ions shows an opposite behavior. Increasing the deuteron energy, the intensity of the neutron radiation increases at a faster rate than it could be assumed on the basis of the increase of the d,d reaction cross section. Bombarding targets with 25-kev deuterons at 1.4 ma/cm^2 the total neutron yield per 1 cm^2 of the wall was = 1.2×10^6 neutrons/sec for Cu and stainless steel and 9.5×10^5 neutrons/sec for Pd. (TTT)

1981

ON THE QUESTION OF THE ANISOTROPY OF CATHODE DISPERSION OF DIELECTRICS. A. I. Krokhina and G. V. Spivak (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 694-7(1960) June. (In Russian)

To observe the eroding effects of ion currents on dielectrics, an experiment was set up in which dielectrics of different structure, NaCl, KCl, and KBr, were bombarded for several minutes by ion beams of current density 10 to 15 ma/cm^2 and energy of 500 to 10,000 ev at a pressure of 10^{-3} mm Hg. It was observed that the dispersion of the dielectric into visibly separate regions was not formed according to the crystalline structure of the target, but rather by a heterogeneous ion current hitting the target. With homogeneous ion currents the cathode dispersion did not take place. Whenever an anisotropic pattern is ascribed to the structure of the target (metal, semiconductor, or dielectric), one must be careful that this dispersion process may not be caused by a nonuniform beam. (TTT)

1982

THE APPLICATION OF THE MASS SPECTROMETER OF THE DYNAMIC TYPE TO THE STUDY OF SECONDARY PROCESSES. A. Kh. Ayukhanov and G. I. Iskhakov (Inst. of Nuclear Physics, Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz. 24, 715-22(1960) June. (In Russian)

Positive sodium and potassium ions of energies 100 to 6000 ev were allowed to bombard films of Na and KCl deposited on a tantalum target. The use of a modulated source and detector permitted the measurement of secondary negative ions emitted under this bombardment. Mass analysis by a 78° analyzing magnet in a vacuum of 7×10^{-6} mm Hg revealed the relative intensities and mass numbers of the negative particles over a mass range 0 to 50 mass units. Figures show these relative intensities and give a coefficient for secondary negative ion emission for 0^- of 100%. Other masses were in much smaller proportion. (TTT)

1983

TRANSFER OF EXCITATION ENERGY IN SOLID SOLUTIONS OF ANTHRACENE-POLYSTYRENE AND 9,10-DIPHENYLANTHRACENE-POLYSTYRENE. L. J. Basile and A. Weinreb (Argonne National Lab., Ill.). J. Chem. Phys. 33, 1028-36(1960) Oct.

The transfer of excitation energy from the excited solvent to the solute was studied as a function of solute concentration for solid solutions of anthracene and 9,10-diphenylanthracene in polystyrene. Transfer efficiencies and fluorescence spectra were obtained for both systems. The fluorescent light pulse of both systems, when excited by electrons and u-v radiation, was recorded and analyzed. Results indicate that radiative transfer predominates at low solute concentration, while at higher solute concentration the transfer process is predominantly nonradiative. Differences between the two systems are probably due to anthracene being chemically bound to the polymer chain, whereas 9,10-diphenylanthracene is not. (auth)

1984

EFFICIENCY OF ENERGY TRANSFER IN A SOLUTION OF PPO IN XYLENE. Isadore B. Berlman (Argonne National Lab., Ill.). J. Chem. Phys. 33, 1124-7(1960) Oct.

The nonradiative energy transfer of an organic scintillating solution (diphenyloxazole in p-xylene) as a function of the solute concentration was determined by three independent methods: direct measurements of the fluorescent lifetime, the light output of the solvent, and the light output of the solute. The efficiency of energy transfer ranges from 12% at 0.02 g/l to 92% at 2 g/l of PPO in xylene. The results from the three methods agree within a few per cent. (auth)

1985

INTER- AND INTRA-ATOMIC CORRELATION ENERGIES AND THEORY OF CORE-POLARIZATION. Oktay Sinanoğlu (Univ. of California, Berkeley). J. Chem. Phys. 33, 1212-26(1960) Oct.

Atomic and molecular energies depend strongly on the correlation in the motions of electrons. Their complexity necessitates the treatment of a chemical system in terms of small groups of electrons and their interactions, but this must be done in a way consistent with the exclusion principle. To this end, a nondegenerate many-electron system is treated here by a generalized second-order perturbation method based on the classification of all the Slater determinants formed from a complete one-electron basis set. The correlation energy of the system is broken down into the energies of pairs of electrons including exchange. Also some nonpairwise additive terms arise which represent the effect of the other electrons on the energy of a correlating pair because of the Pauli exclusion principle. All energy components are written in approximate but closed forms

involving only the initially occupied Hartree-Fock (H.F.) orbitals. Then each term acquires a simple physical interpretation and becomes adoptable for semiempirical usage. The treatment is applied in detail to two particular problems: (a) The correlation energy between an outer electron in any excited state and the core electrons, e.g., in the lithium atom, is represented by a potential acting on the outer one. This potential can be regarded as the mean square fluctuation of the H.F. potential of the core, and applies even when the outer electron penetrates into the core. The magnitudes of some of the correlation effects are calculated for lithium. (b) Starting from a complete one-electron basis set of self-consistent field molecular orbitals, the energy of a molecule is separated into those of groups of electrons and of intramolecular dispersion forces acting between the groups. The assumptions that are usually made in discussing dispersion forces at such short distances are then removed and generally applicable formulas are given. Some three or more electron-correlation effects and limitations in the use of "many electron group functions" for overlapping systems are also discussed. (auth)

1986

CHARGE TRANSFER BETWEEN ATOMIC HYDROGEN AND N^+ AND O^+. R. F. Stebbings, Wade L. Fite, and David G. Hummer (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Chem. Phys. 33, 1226-30(1960) Oct.

The cross sections for charge transfer in collisions between atomic hydrogen and singly charged atomic ions of nitrogen and oxygen were measured within the energy range from 400 to 10,000 ev, using modulated-beam techniques. The results are compared with recent calculations. (auth)

1987

INTERCHANGE OF CHARGE BETWEEN GASEOUS MOLECULES. Donald Rapp and Irene B. Ortenburger (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Chem. Phys. 33, 1230-3(1960) Oct.

The theoretical methods for calculation of charge-exchange cross sections of Gurnee and Magee (J. Chem. Phys. 26, 1237(1957)) were applied to the reactions of hydrogen atoms with H^+, O^+, and N^+. The agreement with experiment (Fite et al., Phys. Rev. 119, 663(1960); Hummer et al., Phys. Rev. 119, 668(1960)) is excellent considering the approximations involved in the theory. (auth)

1988

DIPOLE MOMENT OF LITHIUM HYDRIDE. Lennard Wharton, L. Peter Gold, and William Klemperer (Harvard Univ., Cambridge, Mass.). J. Chem. Phys. 33, 1255(1960) Oct.

The electric dipole moment of lithium hydride was measured using the molecular beam electric resonance method. The results are: for Li^7H: $V = 0$, $\mu = 5.882 \pm 0.003$ D and $V = 1$, $\mu = 5.990 \pm 0.003$ D; for Li^6H: $V = 0$, $\mu = 5.884 \pm 0.003$ D. (D.L.C.)

1989

ON THE FLOW OF AN ELECTRICALLY CONDUCTING FLUID NEAR AN ACCELERATED PLATE IN THE PRESENCE OF A MAGNETIC FIELD. A. S. Gupta (Indian Inst. of Tech., Kharagpur, India). J. Phys. Soc. Japan 15, 1894-7(1960) Oct. (In English)

The flow of an electrically conducting viscous incompressible fluid due to uniformly accelerated motion of an infinite flat plate is discussed. A uniform magnetic field fixed relative to the fluid is supposed to be present. It is found that when the induced field is negligible compared to the imposed field, velocity at any point and at any instant decreases with the increase in the magnetic field strength. It is further shown that the increase in magnetic field results in an increase in the drag suffered by the plate. (auth)

1990

PRODUCTION OF MILLIMICROSECOND CURRENT PULSES USING A PRESSURIZED SPARK GAP. J. H. Adlam and L. S. Holmes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Sci. Instr. 37, 385-8 (1960) Oct.

A pressurized spark gap was designed to discharge a number of coaxial cables in parallel, thus producing a current pulse of 10^4 amp with a rise time of 4.5 mμs. It is intended to use a number of these spark gaps in parallel; and to test the feasibility of doing this, measurements were made of the statistical variation of the time lag for breakdown after triggering. (auth)

1991

PREPARATION OF MASS SPECTROMETER SAMPLES. I. Maass (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 883-7(1960) Sept. (In German)

For the mass spectrometric isotopic analysis it is generally necessary to transform the isotopic samples taken from the investigated process by chemical operations into special chemical compounds that can be introduced into the mass spectrometer. Some examples of such operations are described for the isotopic analysis of carbon, nitrogen, oxygen, sulfur, and lead applied at the Institut für Physikalische Stofftrennung. The methods given in the literature are extended by experience. (auth)

1992

EVALUATION MATHEMATICS OF MASS SPECTROSCOPY. G. Haase (Institut für Physikalische Stofftrennung, Leipzig). Kernenergie 3, 915-17(1960) Sept. (In German)

A short review is given on the mathematical methods of isotopic analysis by mass spectrometry. After the mathematical treatment of the atomic mass peaks the determination of the relative abundances of isotopes in the molecules N_2, O_2, CO_2, SO_2, and CS_2 follows. (auth)

1993

FACTORS IN THE PHOTOGRAPHIC SENSITIVITY TO NUCLEAR PARTICLES. G. Danguy (Université, Liège). Mem. soc. roy. sci. Liège. Collection in 4° (1) 2, No. 4, 1-27(1960). (In French)

A study was made of the effects of agents of a very wide range of energies on primarily experimental emulsions, fine-grained but relatively dispersed. The conditions for optimum sensitivity were determined. It was found that there is a great parallelism between the sensitivity of the emulsions studied with respect to light and strongly ionizing agents. On the other hand, one part of the grains of these emulsions is less sensitive to light regardless of grain size. The study tends to nullify the law of proportionality of sensitivity to the average projected area of the grains. (tr-auth)

1994

ELECTRON IMPACT EXCITATION OF POSITIVE IONS: APPLICATION TO Ca^+ 4s-4p AND 3d-4p. H. van Regemorter. APPENDIX II. NUMERICAL CALCULATIONS. W. Lawson and J. Lawson. Monthly Notices Roy. Astron. Soc. 121, 213-31(1960).

A review is given of different approximate methods for computing cross sections for transitions in positive ions produced by electron impact. It is shown that it is necessary to take into account the distortion by the ion field; and, for strong optically allowed transitions, an allowance for strong coupling effects must be made. Application to the 4s–4p and 4p–3d transitions in singly ionized calcium shows that the neglect of strong coupling effects overesti-

mates the cross sections. However, the results computed with a Coulomb distorted wave approximation with allowance for strong coupling effects were much larger than those of Jefferies, who considered only one value (l = I) of the angular momentum of the incident electron, whereas the main contribution is shown to occur for l = 4. The Bethe approximation with allowance for Coulomb distortion implies in fact two different approximations: the weak coupling approximation and the "long range approximation." It is possible to make corrections for strong coupling effects; and, for strong allowed transitions such as 4s–4p and 4p–3d in Ca^+, this method gives good results in a very simple way. (auth)

1995

DRIFT VELOCITIES OF ELECTRONS IN ARGON, NITROGEN AND ARGON MIXTURES. T. Nagy, L. Nagy, and S. Dési (Central Research Inst. for Physics, Budapest). Nuclear Instr. & Methods 8, 327-30(1960) Sept. (In English)

Drift velocities of electrons produced by fission fragments in a parallel-plate ionization chamber were measured in argon, nitrogen, and mixtures of gases, such as argon-nitrogen, argon-carbon dioxide, and argon-methane. The results obtained are compared with data reported in the literature. (auth)

1996

THE MÖSSBAUER EFFECT AND ITS APPLICATIONS. E. Cotton (Centre d'Études Nucléaires, Saclay, France). Nucleus (Paris) No. 3, 174-83(1960) May-June. (In French)

After a review of the properties of γ rays, the Mössbauer effect is defined and an attempt is made to explain it. Some experiments are described and examples of applications (relativity, Zeeman effect) are given. (T.R.H.)

1997

ON THE QUANTUM CONDITIONS IN FIELD THEORY. [PART] IV. R. S. Liotta (Columbia Univ., New York). Nuovo cimento (10) 17, 703-25(1960) Sept. 1. (In English)

The covariant functional formalism is applied to the Feynman–Gell-Mann spinorial equation. The first order approximation of the W.K.B. method is extended to field theory, giving the corresponding quantum conditions. Applying these results to free fields, a relationship is found between various quantum numbers in field theory. For coupled fields indications are found for a further treatment of the problem. (auth)

1998

MONOCRYSTALS OF ZnS AND THE SPECTRUM OF THEIR ABSORPTION REGION AT LOW TEMPERATURES. E. F. Gross and L. G. Suslina. Optics and Spectroscopy (U.S.S.R.) (English Translation) 6, No. 1, 70-1(1959) Jan.

A study was made of the absorption spectra of thin single crystals at 4.2, 77, and 293°K. In preparing ZnS crystals, the method of heating the powdered ZnS in a neutral gas atmosphere was used. The form and dimensions of the crystals obtained depend largely on such conditions as the vaporization temperature of the powder, the position of the quartz baffles, the velocity of the gas flow, and the temperature gradient near the baffles. Crystals grown for this study were thin colorless plates with maximum dimensions of 25 × 5 mm. The thickness varied from 0.1 mm to tenths of a micron. The crystals of varying thicknesses made possible a thorough study of the long wave natural absorption spectra of 3300 to 3100 A. Heating the crystals from 4.2 to 77°K and then to 20°C displaces the lines in the direction of longer wave lengths and causes them to become diffuse. The position for the absorption lines for the ZnS crystals are tabulated for the various temperatures. (B.O.G.)

1999

ON THE ORIGIN OF CERTAIN ELECTRONIC TRANSITIONS IN NAPHTHALENE CRYSTALS. A. F. Prikhot'ko and M. T. Shpak. Optics and Spectroscopy (U.S.S.R.) (English Translation) 6, No. 1, 73(1959) Jan.

The naphthalene spectra were investigated to verify the origin of electronic transitions in crystals. It appeared that the intensity of lines with transition frequencies ν = 29,941 and 31,060 cm^{-1} in the absorption spectra of single crystals of thickness 1 to 5 mm grown from different preparations differs substantially for different samples. Thus an evolved series related to the transition ν = 29,941 cm^{-1} can appear and disappear in the spectra of single crystals of the same thickness (~5mm); the line ν = 31,060 cm^{-1} can weaken and intensify. This can occur even in compounds that are considered chemically pure. Such changes in the intensities of the spectral bands point to the presence of impurities in the crystal. The addition of β-naphthalene to the sample reinforces the ν = 29,941 cm^{-1} line; the ν = 31,060 cm^{-1} line is intensified by additions of β-methylnaphthalene. It is concluded that the longest wavelength electronic transitions, which are absent in the spectra of the vapors but clearly evident in the crystal spectra, depend on admixtures that are difficult to detect chemically. (B.O.G.)

2000

APPROACH TO EQUILIBRIUM IN QUANTUM SYSTEMS. P. Résibois (Free University, Brussels). Phys. Rev. Letters 5, 411-13(1960) Nov. 1.

Prigogine and his co-workers developed a general theory of approach to equilibrium in classical mechanics. A method is presented which indicates the possibility for obtaining similar results for quantum systems. This method makes use of a representation for the density matrix which stresses the formal analogy between the von Neumann equation and the classical Liouville equation. This representation was used in the particular cases of weakly-coupled systems and of quantum plasmas. (B.O.G.)

2001

MAGNETIC SUSCEPTIBILITY OF THE TWO PHASES OF LITHIUM AT LOW TEMPERATURES. F. T. Hedgcock (Univ. of Ottawa). Phys. Rev. Letters 5, 420-3(1960) Nov. 1.

The Curie method was used to determine the susceptibility of the high-purity lithium samples which were in the form of bare rods. The absolute room temperature susceptibility of the samples was from $(1.89 \pm 0.01) \times 10^{-6}$ to $(1.93 \pm 0.01) \times 10^{-6}$ emu/g and is in reasonable agreement with the value reported by Pugh and Goldman. The temperature dependence of the susceptibility above the phase transformation region (150° to 300°K) showed a slight T^{-1} paramagnetism which indicates paramagnetic impurities in solution. Susceptibility measurements of various samples are tabulated as a function of temperature. Measurements are being continued at higher magnetic fields and attempts are currently being made to reduce the ferrous content of the available lithium samples. Measurements on high-purity distilled sodium are being made where the difficulties of preparing ferrous free samples are not as great as for lithium. (B.O.G.)

2002

EXCITATION PROCESSES IN HELIUM. A. H. Gabriel and D. W. O. Heddle (University Coll., London). Proc. Roy. Soc. (London) A258, 124-45(1960) Oct.

An experimental study of the radiation emitted by helium under controlled electron impact is described. The obser-

vations were analyzed, together with those of previous workers, to yield values for the excitation functions of S, P, and D states. The mechanism of excitation transfer between excited states was analyzed in terms of radiative and collisional processes. Cascade processes were found to be more important than was hitherto assumed. The total inelastic (less ionization) cross section at 108 ev was found to be 2.9×10^{-17} cm^2. (auth)

2003

THE EXCITATION OF THE 2^3P STATE OF HELIUM BY ELECTRON IMPACT. Harrie Massey (University Coll., London) and B. L. Moiseiwitsch. Proc. Roy. Soc. (London) A258, 147-58(1960) Oct. 18.

Cross sections for excitation of the 2^3P state of helium from the ground state were calculated by the distorted-wave method. The polarization of radiation emitted as a result of the excitation was also calculated. Comparison was made with the corresponding results given by the Born–Oppenheimer approximation. Although there were considerable differences at electron energies below 100 ev these were much less marked than for the excitation of the 2^3S state. The distorted-wave method gave cross sections in closer agreement with observation but substantial discrepancies still remained. It was difficult, however, to estimate their magnitude with any certainty because there were inconsistencies in the observed data. (auth)

2004

THE 1s-2s EXCITATION OF HYDROGEN ATOMS BY PROTON IMPACT. A. E. Kingston, B. L. Moiseiwitsch, and B. G. Skinner (Queen's Univ., Belfast). Proc. Roy. Soc. (London) A258, 237-44(1960) Oct. 18.

It is shown that the cross sections for excitations of hydrogen by proton impact, given by the customary second Born approximation, are not reliable because of the neglect of a large term of the fourth order in the interaction energy. The expression for the cross section obtained by including only terms to the third order in the interaction energy was employed to calculate the cross sections for the proton impact excitation of the 2s state of atomic hydrogen. Allowance was made for distortion and polarization due to the 1s, 2s, and $2p_{0,\pm1}$ intermediate states. When polarization was ignored by neglecting all terms involving the 2p states, excellent agreement was found with the distortion approximation calculation of Bates. (auth)

2005

THE 1s-2s EXCITATION OF HYDROGEN ATOMS BY ELECTRON IMPACT. A. E. Kingston, B. L. Moiseiwitsch, and B. G. Skinner (Queen's Univ., Belfast). Proc. Roy. Soc. (London) A258, 245-50(1960) Oct. 18.

The expression for the cross section obtained from the second Born approximation by including only terms to the third order in the interaction energy was employed to calculate cross sections for the electron impact excitation of the 2s level of atomic hydrogen. Allowance was made for distortion and polarization due to the 1s, 2s, and $2p_{0,\pm1}$ intermediate states. These cross sections are compared with the available experimental data. (auth)

2006

ON THE REPRESENTATION OF THE CANONICAL COMMUTATION RELATION OF BOSE FIELDS. Hideo Fukutome (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 989-1002(1960) June. (In English)

A representation of the canonical commutation relation of Bose fields is given in a way which is independent of the choice of the bases of the test functions and covariant with respect to the Euclidean transformation of the coordinate system. It is shown that the representation is characterized by an integral on the conjugate space L^* of the space L of the test functions and a real function on $\Sigma \otimes L^*$ where Σ is the group of the transformations $f \rightarrow u^{-1} f + \varphi$; $f \epsilon L^*$, $\varphi \epsilon L$, and u is a Euclidean transformation of L^*. The conditions for the irreducibility of a representation and the unitary equivalence of the representations and the existence of unique vacuum states are given. An example of the inequivalent Euclidean covariant irreducible representations containing unique vacuum states is given. (auth)

2007

SPATIAL DISTRIBUTION OF ENERGY DEPOSITION BY IONIZING RADIATION. Harald H. Rossi (Columbia Univ., New York). Radiation Research, Suppl. 2, 290-9(1960).

Problems involved in measurements of the spatial distribution of energy deposition in irradiated materials are discussed. Methods are described for the measurement of the linear energy transfer (LET) of charged particles. Data are reviewed from a study of the theoretical evaluation of statistical fluctuations in energy loss. The efficiency of various counting methods is condidered. Data are presented graphically to illustrate the nature of energy deposition and energy transfer. (C.H.)

2008

SOME SPECIAL FEATURES OF A GAS DISCHARGE WITH OSCILLATING ELECTRONS. B. P. Kononov and K. A. Sarksyan (Sarksian) (Lebedev Inst. of Physics, Moscow). Radiotekh. i Elektron. 5, 1717-19(1960) Oct. (In Russian)

The conductivity of a gas discharge with oscillating electrons is investigated. Electron oscillations are produced between specially shaped electrodes without using magnetic fields. (tr-auth)

2009

THERMAL PROPERTIES OF WATER UNDER PRESSURE UP TO 1200 kg/cm^2 AND AT A TEMPERATURE UP TO 300°C. M. P. Vukalovich, B. V. Dzampov, D. S. Rasskazov, and S. A. Remizov (Moscow Inst. of Power Engineering). Teploenergetika 7, No. 7, 4-12(1960) July. (In Russian)

New values are developed for the specific volume of water and the new data are correlated with experimental data of other authors. (tr-auth)

2010

AN EXPERIMENTAL INVESTIGATION INTO HEAT CONDUCTANCE OF WATER VAPOUR. N. B. Vargaftik and A. A. Tarzimanov (All-Union Heat Engineering Inst., USSR). Teploenergetika 7: No. 7, 12-16(1960) July. (In Russian)

Experimental data on the thermal conductivity of water vapor at temperature from 320 to 560°C and pressures from 5 to 500 kg/cm^2 are presented. Further studies on the relation between thermal conductivity and entropy are suggested. (tr-auth)

2011

THE EQUATION OF STATE FOR HEAVY WATER D_2O ACCORDING TO EXPERIMENTAL DATA p-v-T. A. M. Mamedov (Azerbaidzhan Inst. of Petroleum and Chemistry). Teploenergetika 7, No. 9, 71-4(1960) Sept. (In Russian)

An equation for the D_2O liquid phase at 250 to 372°C and 40 to 1000 kg/cm^2 pressure is developed, and a p-v-T table is offered for practical technical applications. The specific volume of ordinary water and heavy water is extrapolated using the developed expression. (R.V.J.)

2012

THE EXPERIMENTAL DATA ON THERMAL CAPACITY OF WATER VAPOR UNDER PRESSURES FROM 300 TO 500 atm AND AT THE TEMPERATURES FROM 500 TO 600°C. A. M. Sirota and B. K. Maltsev (All-Union Inst. of

Heat Engineering, USSR). Teploenergetika 7, No. 10, 67-8 (1960) Oct. (In Russian)

New magnitudes were found for water vapor thermal capacity, c_p, at 300 to 500 atm pressure and temperatures of 500 to 600°C. The data on thermal capacity and enthalpy are tabulated. (R.V.J.)

2013

SOME POSITIVE COLUMN CHARACTERISTICS OF GAS DISCHARGE AT LOW PRESSURES AND HIGH DISCHARGE CURRENT DENSITIES. V. M. Zakharova and Yu. M. Kagan. Vestnik Leningrad. Univ. 14, No. 16, Ser. Fiz. i Khim. No. 3, 44-8(1959). (In Russian)

The electrical characteristics of mercury low-pressure discharge at high-current densities were obtained. Interferometric measurements of the dependence of the directed velocities of ions on gas pressure under these conditions were made. The decrease of normal atomic concentrations at the discharge axis with rising current density and their increase at the tube wall were found. (auth)

2014

RELATION BETWEEN THE FINITE LIFETIME OF AN ION'S EXCITED STATE AND THE LINE SHAPE IN THE DISCHARGE POSITIVE COLUMN. Yu. M. Kagan and V. I. Perel. Vestnik Leningrad. Univ. 14, No. 16, Ser. Fiz. i Khim. No. 3, 49-50(1959). (In Russian)

The finite lifetime of an ion's excited state indicates that the emission line shape does not correspond to the velocity distribution function. The dependence of the half-width and shift of the line shape on the lifetime of the excited state of the ion was found. (auth)

2015

UNTERSUCHUNGEN ÜBER DIE HERSTELLUNG VON KERNSPUREMULSIONEN. (Research on Production of Nuclear-pure Emulsions). Gerhard Heimann. Thesis, Berlin, Technische Universität, 1960. 70p.

An improved process for productions of nuclear-pure emulsions was developed. In contrast to known methods, the precipitation of silver halides from dilute solutions is used. Two concentration conditions are used: 2N salt solution and 7% gelatine solution; 3.5N salt solution and 3.75% gelatine solution. The advantages of the new process are discussed. (T.R.H.)

2016

ENERGIEVERTEILUNG UND AUSBEUTE VON SEKUNDÄRELEKTRONEN AUS DÜNNEN FOLIEN. (Energy Distribution and Yield of Secondary Electrons from Thin Foils). Martin Völker. Thesis, Berlin-Charlottenburg, Technische Universität, 1959. 65p.

Gold, beryllium, and carbon foils of thickness 225 to 1700A were bombarded by 2- to 40-kev electrons. Secondary electron distributions and yields on both sides, as well as fast primary electron scattering, were measured. The energy distributions in all 3 materials are independent of the primary energy and foil thickness. In comparison with other results on solids there were differences only below 1 ev. The curves of secondary electron yield versus primary potential have similar slopes for all 3 substances. The yield on the primary side drops with increasing potential. The curve shows a maximum characterized by the foil. At greater potentials the yields on both sides approach equality. (T.R.H.)

2017

OPTIMIZED SNAP III POWER GENERATOR DESIGN FOR SPACECRAFT. H. H. Greenfield (Lockheed Aircraft Corp., Sunnyvale, Calif.). Paper No. 1278-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 35p.

Design performance studies on the original SNAP III type of thermoelectric generator were made to optimize its use as a power system for special spacecraft missions. From laboratory and analytical studies on the generator's performance and thermal energy rejection characteristics in a space environment, it was determined that the initial available electrical power can be increased by as much as a factor of four. The electrical power is increased by increasing the thermal input of the generator at the expense of conversion efficiency. The modification to the SNAP generator consists of increasing the diameter of the thermoelectric elements and decreasing their length as well as modifying the fuel container and hot shoes to physically accommodate the thermoelectric element. However, the over-all physical characteristics of the SNAP III generator—dimensions, number and type of thermoelectric elements, method of hot and cold junction contacting, hot and cold temperature limits, radial arrangement, number of thermoelectric element rows, and thermal insulation—remain unchanged in the modified design. (auth)

2018

THERMAL CONDUCTIVITY AND PRANDTL NUMBER OF CARBON DIOXIDE AND CARBON-DIOXIDE AIR MIXTURES AT ONE ATMOSPHERE. Jerome L. Novotny (Univ. of Minnesota, Minneapolis) and Thomas F. Irvine, Jr. Paper No. 60-HT-13. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 7p.

By measuring laminar recovery factors in a high velocity gas stream, experimental determinations were made of the Prandtl number of carbon dioxide over a temperature range from 285 to 450°K and of carbon dioxide-air mixtures at an average temperature of 285°K with a predicted maximum error of 1.5%. Thermal conductivity values were deduced from these Prandtl numbers and compared with literature values measured by other methods. Using intermolecular force constants determined from literature experimental data, viscosities, thermal conductivities, and Prandtl numbers were calculated for carbon dioxide-air mixtures over the temperature range 200 to 1500°K for mixture ratios from pure air to pure carbon dioxide. (auth)

2019

A SURVEY OF P-V-T DATA FOR WATER IN THE CRITICAL REGION. E. S. Nowak, R. J. Grosh, and P. E. Liley (Purdue Univ., Lafayette, Ind.). Paper No. 60-HT-25. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 13p.

A comprehensive review is given of P-V-T data available for water at pressures from 2700 to 4000 psia, specific volumes from 0.025 to 0.125 cu ft per lb, and temperatures from about 630 to 800°F. Experimental and computed values of various investigations are given. A description of the various methods and formulas used to interpolate the original data is also given. The results indicate there is a lack of smoothed or computed values for the specific volumes of the superheated vapor at sufficiently close intervals in the critical region. This makes it difficult to interpolate accurately and derive such properties as density and coefficients of volume expansion and compressibility. Furthermore, there are significant differences between the data for superheated steam given in the various tables which can be attributed to erroneous methods of interpolating the original experimental data. (auth)

2020

SMOOTHED PRESSURE-VOLUME-TEMPERATURE DATA FOR WATER IN THE CRITICAL REGION DERIVED FROM EXPERIMENTAL MEASUREMENTS. E. S. Nowak, R. J. Grosh, and P. E. Liley (Purdue Univ., Lafayette, Ind.). Paper No. 60-HT-26. Presented at the 1960 ASME-AIChE Heat Transfer Conference, August 15-17, 1960, Buffalo, New York. New York, The American Society of Mechanical Engineers, 1960. 13p.

A graphical technique was used to derive pressure-volume-temperature data from previous American, Czechoslovakian, and Russian experimental measurements. The data were derived at close intervals throughout the region encompassed by pressures from 3000 to 4000 psia, specific volumes from 0.030 to 0.120 cu ft per lb, and temperatures from 690 to 752°F. The average deviation of experimental values of pressure from the derived values was less than one part in 10,000 in the region for specific volumes greater than the critical volume (0.0525 cu ft/lb) and was less than ten parts per 10,000 in the region for specific volumes less than the critical volume. These deviations are thought to be insignificant since they are entirely within the uncertainty of recent experimental measurements. In a previous paper, deviations of some 100 to 200 parts in 10,000 in pressure were shown to exist between the data of various steam tables. Since the data in the steam tables were derived from the same primary data used in this paper, it may be concluded that these deviations greatly exceed the experimental uncertainty and must therefore be charged to previous interpolation methods and the previous paucity of data. One of the important results of this study was the establishment of the fact that there was excellent agreement between recent measurements by Kirillin, et al. and older measurements by Keyes and Smith and by Havlicek and Miskovsky. (auth)

2021

ION ROCKET EFFICIENCY STUDIES. Guntis Kuskevics (General Electric Co., Cincinnati). p.409-25 of "Xth International Astronautical Congress, London, 1959, Proceedings." Vienna, Springer-Verlag, 1960. (In English)

The energy losses for a general ion rocket engine using a surface ionization ion source are outlined. The surface ionization efficiency is calculated for all alkali metals on tungsten and for Cs on various base metals assuming no adsorption. The adsorption of Cs on tungsten is analyzed by curves showing work function. The rate of energy loss per unit of current is shown to decrease with temperature. The total major loss which is associated with emission and acceleration can be minimized for an optimum design. An extensive bibliography on surface ionization is included. (auth)

2022

KWANTOWA TEORIA ATOMU. (Quantum Theory of the Atom). Wojciech Rubinowicz. Warsaw, Panstwowe Wydawnictwo Naukowe, 1957. 556p.

Earlier and later quantum theories are treated in separate parts. The first part covers such topics as the state of the quantized atom, spectrum of a one-electron atom, problems of the correspondence principle, general properties of spectra of many-electron atoms, and structure of grouped spectral terms. The foundations and simple problems of wave mechanics, physical interpretation of the later quantum theory, excited states of excited systems, Dirac equation, quantization of electromagnetic fields, and emission and absorption of light are included in the second part. (D.L.C.)

2023

THERMOMETRY AT LIQUID HELIUM AND LIQUID HYDROGEN TEMPERATURES. Marten Durieux. Thesis, Leiden, Rijksuniversiteit, 1960. 120p.

The vapor pressure–temperature relations for liquid He^4 and H_2 were determined using magnetic measurements on salts in thermal equilibrium with the two liquids. The results are compared with earlier temperature scales. The use of these two liquids as vapor-pressure thermometers is discussed. (D.L.C.)

Astrophysics and Cosmology

2024

SEARCH FOR EXTINCT LEAD 205 IN METEORITES. Edward Anders (Univ. of Chicago) and Charles M. Stevens. J. Geophys. Research 65, 3043-7(1960) Oct.

The isotopic composition of thallium from six meteorites was measured, to determine whether any radiogenic Tl^{205} from the decay of 24-m.y. Pb^{205} was present. Although the Pb/Tl ratios of these meteorites differed by factors of 50, isotopic compositions of meteoritic and terrestrial thallium were equal to within 1%. For Canyon Diablo, this implies a solidification time of $\geq 3.0 \times 10^8$ years after nucleogenesis by the 'sudden synthesis' model, and $\geq 1.0 \times 10^8$ years after the isolation of the solar system by the 'continuous synthesis' model. The bearing of these results on the I^{129}–Xe^{129} ages of Reynolds is discussed. (auth)

2025

THE GROSS CHARACTER OF THE GEOMAGNETIC FIELD IN THE SOLAR WIND. Francis S. Johnson (Lockheed Missiles and Space Div., Palo Alto, Calif.). J. Geophys. Research 65, 3049-51(1960) Oct.

The effect of a rapidly moving highly conducting solar plasma, or solar wind, on the earth's magnetic field should be to deform it and confine it; it should not be to pull out to infinity magnetic lines of force which otherwise would lie close to the earth. At low latitudes the geomagnetic field is strengthened by the interaction at all distances from the earth out to the confining boundary, beyond which there is solar plasma and no geomagnetic field. At high latitudes, the geomagnetic field is weakened by the confining action of the solar wind. The shape that the deformed geomagnetic field should assume is roughly that of a tear drop; the marked lack of symmetry in the deformed field must be an important factor in space investigations such as measurements of trapped radiation or geomagnetic field. The boundary between the geomagnetic field and the solar plasma should be turbulent; there is a possibility that the presence of the hydromagnetic waves generated by the turbulence will open the tail of the tear drop, thus modifying the confinement of the field by the solar wind. (auth)

2026

QUANTUM ELECTRODYNAMICS IN AN EXPANDING UNIVERSE. F. L. Scarf (Univ. of Washington, Seattle). Nuovo cimento (10) 17, 375-83(1960) Aug. 1. (In English)

The equations of quantum electrodynamics are investigated in an expanding universe characterized by a de Sitter metric. It is assumed that the expansion occurs on a microscopic level and that the bare electron mass, $\hbar$, and the bare charge are all constant. For a particular coordinate system, the operators may be expressed in terms of coupled flat-space fields that have m replaced by mR(t). The equivalent quantized field problem is soluble using standard perturbation theory with modified commutators and Green's functions. As a first approximation, adiabatic changes caused by the expansion are evaluated by making the replacement $m \rightarrow mR$ in all final formulas. Renormalization effects are examined using asymptotic expressions that contain ultraviolet cut-offs. With the

assumption that the cutoff procedures are meaningful and are related to the structure of the physical electron, it is noted that the renormalized mass and charge could vary with time for a particular kind of cut-off process. (auth)

2027

SEARCH FOR γ RADIATION FROM THE CYGNUS A RADIOSOURCE. A. Braccesi, M. Ceccarelli (Università, Bologna) and G. Salandin. Nuovo cimento (10) 17, 691-4 (1960) Sept. 1. (In English)

An experiment is described for detecting energetic γ radiation from a peculiar celestial object (Cygnus A) interpreted as a collision between a galaxy of matter and one of anti-matter. The experiment was negative and settled as upper limit for the γ flux a value of about 5×10^{-3} quanta/cm^2/sec, which is about two orders of magnitude smaller than estimated by Morrison under the assumption previously mentioned. (auth)

2028

MEASURING THE MAGNETIC FIELDS OF THE EARTH AND MOON BY MEANS OF SPUTNIK III AND SPACE ROCKETS I AND II. S. Sh. Dolginov, E. G. Eroshenko, L. N. Zhuzgov, N. V. Pushkov, and L. O. Tyurmina (Academy of Sciences, Moscow). p.863-8 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

Magnetic-field measurements of the earth and the moon were made. It is shown that the magnetic-field effects are associated with the outer radiation belt and that the magnetic field of this belt is created primarily by drift currents made of protons and positive ions. Measurements made by means of Space Rocket II showed that the intensity of the lunar magnetic field was at least 400 times less than the magnetic-field intensity at the surface of the earth. (auth)

Cosmic Radiation

2029 INSJ-26

Tokyo Univ. Coll. of General Education.

THE ENERGY SPECTRA OF THE PRIMARY HEAVY NUCLEI OBSERVED ON SEPTEMBER 11, 1957 AT PRINCE ALBERT, CANADA. Kei Yokoi. May 1, 1960. 45p.

Issued by Tokyo Univ. Inst. for Nuclear Study.

The subrelativistic part of the energy spectra of primary medium ($6 \leq z \leq 9$) and heavy ($Z \geq 10$) nuclei was determined by the measurement of the interacting tracks caught in the Prince Albert Stack. By this measurement the results obtained previously were cross-checked and confirmed. The spectra were extended up to 1 Bev/nucleon. The flux values of these nuclei of energy >1 Bev/nucleon were obtained. An attempt was made to determine the flux values of nuclei of energy >5 Bev/nucleon by the measurement of high energy knock-on electrons. (auth)

2030

METEORITES AS SPACE PROBES FOR TESTING THE SPATIAL CONSTANCY OF COSMIC RADIATION. R. W. Stoenner, O. A. Schaeffer, and R. Davis, Jr. (Brookhaven National Lab., Upton, N. Y.). J. Geophys. Research 65, 3025-34(1960) Oct.

An experiment was performed to test the spatial constancy of cosmic radiation within the solar system by measuring a short-lived and long-lived cosmic-ray-induced radioactivity in a recently fallen stone meteorite. The measurement was performed on the Hamlet chondrite that fell in Indiana on October 13, 1959. The ratio of the 35-day Ar^{37} to the 325-year Ar^{39} was found to be 2.0 ± 0.3. The relative production rates for these isotopes were determined by bombarding the meteorite with 3-Bev protons. The ratio of the Ar^{37} to Ar^{39} production rates was found to be 1.5 ± 0.2. Since the ratios were the same within experimental uncertainty, it was concluded that the flux of cosmic radiation is constant in the space between the earth and the asteroidal belt. The Ar^{39} contents of four other chondrites were measured. The values obtained were as follows: Richardton 7.1 ± 0.6, Murray 9.4 ± 0.5, Forest City 11.9 ± 0.5, Benton 9.0 ± 0.4, and Hamlet 7.8 ± 0.2 dis/min/kg. (auth)

2031

ARGON-37, ARGON-39, AND TRITIUM IN METEORITES AND THE SPATIAL CONSTANCY OF COSMIC RAYS. E. L. Fireman and J. DeFelice (Smithsonian Astrophysical Observatory, Cambridge, Mass.). J. Geophys. Research 65, 3035-41(1960) Oct.

The radioactive isotopes Ar^{37}, Ar^{39}, and tritium are measured in the Hamlet chondritic meteorite and in the Aroos iron meteorite. The ratio of the radioactivity of Ar^{37} to that of Ar^{39} at the time of fall is 2.3 ± 0.2 for the Hamlet meteorite and 1.4 ± 0.3 for the Aroos meteorite. The ratio of the production rate of Ar^{37} to that of Ar^{39} in a sample of the Hamlet meteorite irradiated with 2-Bev protons is 1.2 ± 0.3. These measurements indicate a higher flux of cosmic rays at a distance of 1 astronomical unit from the sun than at several astronomical units. The ratio of the radioactivity of tritium to that of Ar^{39} is 29 ± 6 for the Hamlet meteorite and 2.0 ± 0.5 for the Aroos meteorite. The ratio of the production rates in the Hamlet target sample is 24 ± 6. The ratio of tritium to Ar^{39} in the Benton chondritic meteorite is 29 ± 4. The data indicate that the cosmic-ray flux integrated over the same region of space for different times is constant. The tritium is anomalously low in the Aroos iron meteorite. Similar tritium anomalies were observed previously in iron meteorites. (auth)

2032

THE RADIATION BELT PRODUCED BY NEUTRONS LEAKING OUT OF THE ATMOSPHERE OF THE EARTH. Wilmot N. Hess (Univ. of California, Livermore). J. Geophys. Research 65, 3107-15(1960) Oct.

The experimental information about the radiation belt is summarized. Calculations of the radiation belt spectra and fluxes based on the neutron decay source are compared with the experiments. The purpose is to find out in what ways the neutron decay source explains the observed features of the radiation belt and where other sources may be needed. The conclusion reached is that the inner zone of the radiation belt is quite likely supplied by neutron decay alone and the e_2 region of the outer zone may well be due to neutrons alone but that there may be as well as the neutron source another source of particles that supplies electrons of less than 100 kev to the e_2 region of the outer zone. (auth)

2033

GEOMAGNETIC FLUCTUATIONS AND THE FORM OF THE OUTER ZONE OF THE VAN ALLEN RADIATION BELT. E. N. Parker (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Geophys. Research 65, 3117-30(1960) Oct.

It is demonstrated by formal calculation that the large-scale geomagnetic fluctuations observed at ground stations result in a rapid and somewhat remarkable kind of diffusion of the electrons in the outer zone of the Van Allen radiation belt. An initial thin ring of electrons will give

an immediate finite particle flux at infinity, at the same time that the group of the particles remaining moves radially inward as a 'wave.' A decline of the particle counting rate is predicted beyond about 4 earth radii of the order of $1/r^{\beta}$, where $\beta \cong 12$ to 16, depending upon the kind of counter, in agreement with the many observations. (auth)

2034

SOLAR CORPUSCULAR RADIATION AND POLAR IONOSPHERIC DISTURBANCES. Tatsuzo Obayashi, and Yukio Hakura (Hiraiso Radio Observatory, Radio Research Labs., Nakaminato-shi, Ibaragi-ken, Japan). J. Geophys. Research 65, 3131-42(1960) Oct.

Study of disturbances in the polar ionosphere yields considerable evidence of the existence of energetic solar particles associated with solar flares. Radio blackouts due to enhanced ionizations are classified into two characteristic types: the polar-cap blackout, and the auroral-zone blackout. It is shown that the polar-cap blackout appears with some hours' delay after a major solar radio out-burst of type IV, and is confined within the geomagnetic latitude of about 60 to 65°. The estimated energies of particles causing it are of about 10 to 100 Mev. The auroral-zone blackout follows, accompanied by geomagnetic storms and auroras; it may be caused by the so-called auroral particles of 1 Mev or less. The energy spectrum of solar particles associated with solar flares is discussed in view of these results and of information from various observations of solar and terrestrial disturbances. It is concluded that solar particles have a conspicuous suprathermal non-Maxwellian tail extending from a few kev to relativistic energy ranges, though the main part of corpuscular clouds consists of particles of rather low energy, which are likely to be in the Maxwellian distribution. The nature of solar corpuscular clouds and their effect upon the terrestrial ionosphere are discussed. (auth)

2035

PROPAGATION OF SOLAR COSMIC RAYS THROUGH INTERPLANETARY MAGNETIC FIELD. Tatsuzo Obayashi and Yukio Hakura (Hiraiso Radio Observatory, Radio Research Labs., Nakaminato-shi, Ibaragi-ken, Japan). J. Geophys. Research 65, 3143-8(1960) Oct.

In recent years evidence has accumulated that low-energy solar cosmic-ray particles arrive at the earth after intense solar disturbances. The time-delay of polar-cap absorptions and of geomagnetic storms, which follow after an intense solar radio outburst of type IV, indicates that solar cosmic-ray particles originating to the west of the solar central meridian reach the earth earlier and more easily than those from the east. The model of the interplanetary magnetic field, which may be appropriate for the explanation of this evidence, is as follows: The interplanetary magnetic field is formed by the outward-streaming solar winds which carry the imbedded solar magnetic fields and the lines of force linked with the sun. The rotation of the sun produces a curvature of streams and consequently of the lines of force, which are convex toward the west. Since the injected solar particles tend to travel along the existing magnetic lines of force, this model explains the western excess of the arrival of solar cosmic rays as well as the inequality of their travel time with respect to the heliographic position. The estimated intensity of the magnetic field is of the order of 10^{-3} to 10^{-5} gauss near the earth's orbit. (auth)

2036

THE SOLAR DAILY VARIATION OF THE COSMIC RADIATION: WORLD-WIDE NEUTRON MONITOR OBSERVATIONS DURING THE INTERNATIONAL GEOPHYSICAL YEAR. Georges Schwachheim (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). J. Geophys. Research 65, 3149-57(1960) Oct.

An analysis is given of the quiescent solar daily variation of the cosmic radiation, as recorded by neutron monitors during the International Geophysical Year. The amplitude of the first harmonic as a function of latitude shows a decrease at polar regions but is otherwise constant at 0.3%. The time of maximum increases from 13 to 17 hours local time from the equator to the pole. The amplitude of the second harmonic is 0.06%, and its time of maximum is 1 hour local time. The world-wide correlation of the results is examined. (auth)

2037

EFFECTS OF SHORT-TERM WORLD-WIDE MODULATION OF THE PRIMARY COSMIC RADIATION ON OBSERVED DAILY INTENSITY VARIATIONS. N. R. Parsons (Anarctic Division, Department of External Affairs, Melbourne, Australia). J. Geophys. Research 65, 3159-61(1960) Oct.

The possible magnitude of contributions to the observed solar daily variation of cosmic-ray intensity made by irregular short-term fluctuations of the primary intensity is discussed. It is shown that such fluctuations of an average type and range not inconsistent with observed patterns of change in bihourly intensity values could contribute important spurious universal time components to short-period mean daily variations. (auth)

2038

HIGH NEUTRON AND RADIATION INTENSITIES AT BALLOON ALTITUDES DURING AURORAL DISPLAY. S. A. Korff and R. C. Haymes (New York Univ., New York). J. Geophys. Research 65, 3163-7(1960) Oct.

A balloon flight at 40-km altitude, instrumented with neutron counters, recorded high neutron intensities as well as high ionization levels during an auroral display. The observations are consistent with the possibility that the neutrons were produced by protons of 50 or more Mev in energy at the balloon's altitude. (auth)

2039

DISCUSSION OF PAPER BY R. L. ARNOLDY, R. A. HOFFMAN, AND J. R. WINCKLER, "OBSERVATIONS OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER 1959, PART I." A. J. Dessler (Lockheed Aircraft Corp., Missiles and Space Div., Palo Alto, Calif.). J. Geophys. Research 65, 3487-90(1960) Oct.

Arnoldy et al. reported a value of 1.2×10^{15} m^{-2} sec^{-1} for the omnidirectional electron flux at the peak of the outer zone of the Van Allen belt. It is pointed out that their value is inconsistent with other radiation measurements and geomagnetic field data. (B.O.G.)

2040

CHARGED-PARTICLE VARIATIONS IN THE OUTER VAN ALLEN ZONE DURING A GEOMAGNETIC STORM. T. A. Farley and A. Rosen (Space Technology Labs., Inc., Los Angeles). J. Geophys. Research 65, 3494-6(1960) Oct.

Comments and data are presented on the phenomena observed by instruments on the Explorer VI satellite. The data associated with the intense and unusual fluctuations in the particle intensity of the August 16, 1959, geomagnetic storm were compared with the data obtained by the spin coil magnetometer. This comparison revealed that a 180° out-of-phase correlation existed between the particle intensity and the magnetic field strength. The storm was accompanied by an increase in the scintillation count rate in the outer zone within 12 hr following the sudden commencement of the storm, whereas the instruments

sensitive to bremsstrahlung from electrons showed a decrease. These observations are consistent with the geomagnetic storm model of Dessler and Parker, and the confirmation of the increase of energetic protons in the geomagnetic field during a storm makes plausible the establishment of the field stresses which account for the main phase of a geomagnetic storm in that model. (B.O.G.)

2041

COSMIC RAY AND GEOMAGNETIC DISTURBANCES FROM JULY 1957 TO JULY 1958. PART I. THE COSMIC RAY EVENTS AND THEIR CORRELATION WITH THE GEOMAGNETIC EVENTS. F. Bachelet, P. Balata, A. M. Conforto, and G. Marini (Università, Rome; Istituto Nazionale di Fisica Nucleare, Rome; and Commissione Italiana Anno Geofisico Internazionale, Rome). Nuovo cimento (10) 16, 292-319(1960) Apr. 16. (In English)

Cosmic Ray Storms (CRS), i.e. world-wide decreases of the C.R. intensity as measured by standard neutron monitors in Rome and in other parts of the world, were systematically investigated during the period July 1957 to July 1958, in correspondence with Magnetic Storms (MS). The correlations CRS — MS and MS — CRS were examined. The characteristic features of both classes of events were considered in order to find out which of them were preferential for the association itself. Some aspects of the correlation were approached by statistical methods. (auth)

2042

COSMIC RAY AND GEOMAGNETIC DISTURBANCES FROM JULY 1957 TO JULY 1958. PART II. THE GEOMAGNETIC EVENTS. F. Bachelet, P. Balata, A. M. Conforto, and G. Marini (Università, Rome; Istituto Nazionale di Fisica Nucleare, Rome; and Commissione Italiana Anno Geofisico Internazionale, Rome). Nuovo cimento (10) 16, 320-31 (1960) Apr. 16. (In English)

The Magnetic Storms (MS) which occurred in the period July 1957 to July 1958 are selected and classified in view of an analysis of their correlation with Cosmic Ray Storms. The methods and the criteria employed are described. A list of all geomagnetic events thus identified is reported. (auth)

2043

ON THE ANISOTROPY OF THE COSMIC RADIATION. E. W. Kellermann and M. S. Islam (Univ. of Leeds, Eng.). Nuovo cimento (10) 17, 334-42(1960) Aug. 1. (In English)

An attempt was made to reproduce some results of McCusker and his coworkers who had reported diurnal effects of cosmic-ray showers. The design of the apparatus follows closely that of these workers but allows more detailed information about each recorded event to be obtained. The main categories of observed events, including those examined by McCusker et al., show no significant diurnal variation. A possible sidereal diurnal variation of a particular group of events is critically examined; and it is concluded that, in spite of strong statistical weight, the implications of accepting the variation as physically real do not at present allow it to be regarded as such. (auth)

2044

ON AN ATTEMPT OF DETECTION OF PRIMARY COSMIC PHOTONS OF VERY HIGH ENERGY. R. Maze (Ecole Normale Supérieure, Paris) and A. Zawadzki. Nuovo cimento (10) 17, 625-33(1960) Sept. 1. (In English)

In relation to the primary proton flux of very high energy ($(10^{15}$ to $10^{16})$ ev), the possible photon flux of equal energy created by the p-p collisions of protons with the diffused matter of the universe is evaluated considering the multiple production of the π^0-mesons and their decay. If a trace of very high energy photons exists among the primary flux, two types of EAS must be produced in the air: 1) ordinary EAS; 2) pure photon-electron cascades. Taking advantage of the difference between the number of electrons produced at sea level by a protonic and by a photonic EAS of equal energy (therefore resulting in an amplification factor of the observable effect by at least ten times) it is shown that it is possible to separate these two types by studying the penetrating component with the help of a large detection area and to disclose a real limit rate as small as 10^{-4}. Considering current cosmological estimates, it gives some possibility of observing a significant rate. This method may give new experimental information on the origin of cosmic rays and on individual interaction at very high energy. (auth)

2045

DIFFUSION OF PARTICLES IN THE EARTH'S RADIATION BELTS. N. Herlofson (Royal Inst. of Tech., Stockholm.) Phys. Rev. Letters 5, 414-16(1960) Nov. 1.

Observations of the particle density near the equatorial plane at different distances from the earth are compared with a theoretical study of the diffusion of charged particles injected into the geomagnetic field well beyond the outer radiation belt and subsequently scattered by fluctuating electric or magnetic fields. A survey of the diffusion process is made by considering a system with spherical symmetry, where particles are injected uniformly over a spherical shell. As the distribution widens, the particles closer to the earth are impeded by the diminishing diffusion coefficient, whereas the particles further away are rapidly dispersed. An asymmetric distribution develops with a steep slope facing the earth and a more gradual decrease outward. (B.O.G.)

2046

THE RECOVERY OF COSMIC-RAY EMULSIONS FROM ROCKET AND SPACE PROBES. Herman Yagoda (Ionospheric Physics Lab., Bedford, Mass.). Phys. Today 13, No. 10, 18-25(1960) Oct.

The first rocket-exposed emulsion was recovered September 1949, after exposure at 151 km. A star population of 5420 ± 1300 cc^{-1} day^{-1} was indicated, larger than shown in similar emulsions exposed by balloon (815 ± 104 cc^{-1} day^{-1}) in the stratosphere. The second recovery was effected from an Aerobee rocket that reached 128 km. The emulsion was indicative of a star production rate of 4800 ± 1000 cc^{-1} day^{-1}. The third recovery yielded a value of 1180 ± 280 stars/cc/day, which was consistent with stratospheric measurements. Photomicrographs are shown of particle tracks in the developed emulsions flown in balloons and rockets. (B.O.G.)

2047

LATITUDE DEPENDENCE OF THE DAILY VARIATION OF COSMIC RAY INTENSITY. R. P. Kane and S. R. Thakore (Physical Research Lab., Ahmedabad, India). Proc. Indian Acad. Sci., Sec. A 52, 122-9(1960) Sept. (In English)

The yearly average daily variation curves for the period July 1957 to June 1958 for data from neutron monitors operated at various places during the I.G.Y. are harmonically analyzed. Data for different latitude belts are grouped together. The amplitude and hour of maximum of the first harmonic show a marked latitude dependence. It is found, however, that stations in the same latitude belt show large differences in amplitudes. Possible reasons for such differences are discussed. It is concluded that these differences are due to extraneous unspecified factors and that the published data are not suitable for analysis without further scrutiny. (auth)

2048

SOLAR MODULATION OF PRIMARY COSMIC RAYS. Yoshinosuke Terashima (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1138-50(1960) June. (In English)

It is proposed that the solar modulation of cosmic rays is accounted for in terms of a combined model, for which disordered as well as ordered magnetic fields are responsible. These magnetic fields are considered to be of solar origin. The diffusion region of disordered magnetic fields is assumed to extend widely over the solar system and takes part in the modulation of the low energy part of primary cosmic rays. Special account is given for the interpretation of the characteristic shape of the low energy spectra common to all heavy primary cosmic rays recently observed. The eleven-year variations are ascribed to the superposition effect of ordered magnetic fields distributed near the earth orbit. The diurnal variations are shown to be a direct consequence of the present model. The arguments are based upon the assumption of two kinds of solar streams: the continuously ejected streams and the more intense ones produced by solar eruptions. A quantitative estimate of the physical parameters to describe the present model is worked out. (auth)

2049

IONOSPHERIC POSITIVE IONS. C. Y. Johnson and J. C. Holmes (Naval Research Lab., Washington, D. C.). p.417-19 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

During the International Geophysical Year, four rockets carrying mass spectrometers were fired into the Arctic ionosphere. The relative abundance of ions of mass 32, 30, and 16 were measured between 90 and 250 km. The significance of mass 28 and mass 18 ions is discussed. The mechanics of this measurement are examined briefly. (auth)

2050

TERRESTRIAL CORPUSCULAR RADIATION AND COSMIC RAYS. S. N. Vernov and A. E. Chudakov (Academy of Sciences, Moscow). p.751-96 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

Information obtained during the flights of the second and the third Soviet Sputniks and the first and the second Soviet Cosmic Rockets is presented. The methods are described by which the existence of the outer radiation belt of the earth was discovered and the radiation composition in this belt was determined. The flux of the electrons of energy >0.5 to 1.0×10^6 ev was $10^5/cm^2/sec/sterad$; the flux of the electrons of energy $>5 \times 10^6$ ev was $<0.1/cm^2/sec/sterad$. It is shown that there are protons of energy 10^8 ev (their flux is $10^3/cm^2/sec/sterad$) in the composition of the inner radiation belt. At the edge of the inner zone, in the region of geomagnetic latitudes 35 to 40°, particles of low energies were found. These particles were probably electrons. The calculations showed that high-energy protons could be created by the decay of albedo neutrons. Beyond the earths magnetic field there is the following flux of radiations. The flux of charged particles is $2/cm^2/sec/sterad$; the mean ionizing capacity is 2.5 times higher than minimum one. The flux of photons of energy >450 kev is $<0.1/cm^2/sec/sterad$, and the same of energy >45 kev is $<3/cm^2/sec/sterad$. (auth)

2051

ON THE NATURE AND ORIGIN OF THE EARTH'S RADIATION BELTS. S. F. Singer (Univ. of Maryland, College Park). p.797-820 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

A brief historical introduction traces the ideas that led to the prediction and eventual discovery of geomagnetically trapped radiation. It is concluded that the cosmic-ray neutron albedo theory accounts well for the inner belt. The spatial distribution of high-energy protons around the earth, including their dependence on altitude and latitude, was derived. The extension of the theory gave the energy spectrum of these protons which was also in good accord with observations. The motion of the trapped particles produces magnetic effects. Here again the theory was well supported by direct observations carried out in the Lunik I rocket. Finally the relation of geomagnetically trapped radiation to magnetic storms is discussed. (auth)

2052

PHYSICAL PROPERTIES IN THE OUTER VAN ALLEN BELT AND THEIR RELATIONS TO THE PHENOMENA IN THE EXOSPHERE. Y. Inoue (Technical Research Inst., National Defense Agency, Tokyo). p.828-40 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

On the basis of observed data on corpuscular radiation in the exosphere, the electron temperature and density in the outer Van Allen belt were estimated. The electron temperature is 2.4×10^{6}°K, the total electron density is 3.5×10^2 cm^{-3}, and the mean kinetic energy of electrons is 32 kev. The estimated total electron density is in precise agreement with the ion density measured with the USSR moon rocket (Jan. 2, 1959) in the exosphere. The time for replacing old particles with new particles in the outer Van Allen belt is estimated to be 73 years. Electrons and protons trapped in the exosphere leak into the auroral zones as auroral particles. The estimated average flux of aurorae particles is 1.4×10^6 particles/cm^2/sec. The total flux over the active region is 3.6×10^3 ($4\pi R_{\oplus}^2$) particles/sec. The volume of the exosphere that contributes to the flux of auroral particles is 1.1×10^2 ($\frac{4}{3}\pi R_{\oplus}^3$). Local equilibrium is maintained between the mechanical force from the electric current and the pressure gradient. The pressure and pressure gradient are derived. (auth)

2053

RADIATION MEASUREMENTS DURING THE FLIGHT OF THE SECOND SOVIET SPACE ROCKET. S. N. Vernov, A. E. Chudakov, P. V. Vakulov, Yu. I. Logachev, and A. G. Nikolaev (Nikolayev) (Academy of Sciences, Moscow). p.845-51 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

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2054

COSMIC RAY INVESTIGATION BY THE SECOND COSMIC ROCKET LANDED ON THE MOON. L. V. Kurnosova, V. I. Logachev, L. A. Razorenov, and M. I. Fradkin (Academy of Sciences, Moscow). p.852-62 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl.

ed. Amsterdam North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

The second Soviet space rocket carried two Čherenkov counters for recording primary cosmic-ray nuclei, one of which recorded α particles, the other nuclei with charges exceeding 5 and 15. A separate channel, termed the radiation monitor, was provided for detecting the intensity of all charged particles. The maximum intensity in the radiation belt was at a distance of 17,000 km from the center of the earth. It was much higher, and 10,000 km nearer the earth, than the maximum found by the first space rocket. Near the moon the radiation intensity was within the limit of twice the counting rate produced by cosmic radiation. At great distances from the earth, the ratio of fluxes of nuclei with $Z > 2$, 5, and 15 was 1000 : 75 : 3. At 10,000 to 30,000 km, there was a large increase in the counting rate of the channel for detecting α particles. This increase may be due to the accumulation of energetic α particles in orbits around the earth or to the effect of the radiation belt on the instruments, but it is not yet possible to reach a definite decision. (auth)

2055

MEASUREMENTS OF THE VAN ALLEN RADIATION BELTS DURING GEOMAGNETIC STORMS. R. Arnoldy, R. Hoffman, and J. R. Winckler (Univ. of Minnesota, Minneapolis). p.877-96 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

The University of Minnesota experiment in the Explorer VI satellite consisted of an integrating ion chamber and a Geiger counter with suitable sensitivity for exploring the radiation belts around the earth. From the first two week's data, a contour map was constructed of the radiation regions, which appeared to have shrunk considerably since previous measurements in the spring of 1959. Values of radiation intensity up to 10 r/hr were observed. During the magnetic storm of Aug. 16 and 17, a substantial depression in the radiation zone was noted. The decrease in the number of trapped electrons during the negative phase of this storm was sufficient to produce the x radiation seen during intense aurorae at balloon altitudes. On the assumption that the electrons are precipitated into the atmosphere and produce the observed bremsstrahlung, the latitude of maximum precipitation was found to be at 57° geomagnetic. The balloon observation that auroral x rays are seen at Minneapolis, but not with high intensity in the auroral zone, is thus explained. Great increases in the outer zone were observed during the last ten days of August, associated with high solar radio activity. (auth)

2056

ENERGY SPECTRA AND ALTITUDE DEPENDENCE OF ELECTRONS TRAPPED IN THE EARTH'S MAGNETIC FIELD. M. Walt (Lockheed Missiles and Space Div., Palo Alto, Calif.), L. F. Chase, Jr., J. B. Cladis, W. L. Imhof, and D. J. Knecht. p.910-20 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

Measurements of the intensity and energy spectrum of electrons trapped in the geomagnetic field were made using a magnetic spectrometer carried by a four-stage solid-propellant rocket. The rocket was launched from Wallops Island, Va., and reached an altitude of 1045 km. Energy spectra were obtained as a function of altitude over the energy interval from 30 kev to ~1 Mev. At all altitudes the number of electrons per unit energy interval decreased with increasing energy. The flux of electrons with energy greater than 1.5 Mev and protons with energy greater than 1 Mev was found to be less than one-hundredth the flux of electrons between 30 kev and 1 Mev. A Schonstedt magnetometer was used to correlate the direction of the measurements with the direction and intensity of the geomagnetic field. (auth)

2057

SOFT RADIATION MEASUREMENTS ON EXPLORER VI EARTH SATELLITE. Alan Rosen, T. A. Farley, and C. P. Sonett (Space Technology Labs., Inc., Los Angeles). p.938-50 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

Electrons above 200 kev and protons above 2 Mev at radial distances of 6600 to 48,800 km were measured with a scintillation counter mounted in the Explorer VI earth satellite. The spatial distribution of trapped radiation in the Van Allen zones is presented by an isointensity plot, curves showing variations with radial distance at constant geomagnetic latitude, and curves showing variations with geomagnetic latitude at constant radial distance. A charged-particle flux in excess of 10^8 particles/cm^2/sec was observed in regions of high intensity near the geomagnetic equator. Both daily fluctuations and sharp short-term variations in the radiation flux were observed in the outer Van Allen region. The fluctuations are discussed in terms of magnetic storms and solar activity, and certain theoretical mechanisms for the variations are mentioned. (auth)

2058

TRAPPED AND COSMIC RADIATION MEASUREMENTS FROM EXPLORER VI. C. Y. Fan (Enrico Inst. for Nuclear Studies, Chicago), Peter Meyer, and J. A. Simpson. p.951-66 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

The earth-satellite Explorer VI was placed in an elliptic orbit that passed through both the regions of geomagnetically trapped radiation and the regions at greater distances from the earth. An instrument that measures protons $\geq$ 75 Mev (or electrons $\geq$ 13 Mev) separately from, and in the presence of, bremsstrahlung-producing trapped electrons was used to investigate three problems: the structure of the Van Allen radiation regions and changes of structure with time; the detection of solar flare high-energy particles; and the electromagnetic phenomenon of solar origin which leads to modulation of cosmic-ray intensity. This is a preliminary report on these studies. (auth)

2059

THE VARIATION OF THE COSMIC RAY INTENSITY DURING A SOLAR CYCLE. F. B. McDonald (Goddard Space Flight Center, National Aeronautics and Space Administration, Washington, D. C.), and William R. Webber. p.968-81 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

The intensity and energy of the primary-cosmic-ray proton and α-particle components were measured on a series

of 20 Skyhook balloon flights. These flights were provided by the Office of Naval Research and reached an average residual atmospheric depth of 6 g/cm^2. The measurements spanned the period from Jan. 1955 to June 1959, and they covered the interval from the minimum of solar activity to the recent period of maximum activity. Large changes in the primary cosmic radiation were observed and, as was reported previously by others, these changes displayed an inverse correlation with solar activity. A large number of cosmic-ray geomagnetic cutoff's were measured. These measurements placed strong constraints on the nature of the modulating mechanism. They seemed to indicate that the changes produced in the low-rigidity portion of the spectra are the same for the Forbush decrease as for the 11 year variation. None of the proposed mechanisms for modulating the primary-cosmic-ray intensity appeared to fit the experimental data. (auth)

2060

ELECTRIC FIELD MODULATION. A. Ehmert (Max-Planck-Institut für Aeronomie, Lindau über Northeim, Ger.). p.1000-8 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

The experimental rigidity spectra of the primary-cosmic-ray protons and α particles are quantitatively described by a varying electric tension of the earth that decelerates the cosmic-ray particles which originally have a differential energy distribution $E_{kinetic}^{-2.5}$. The decelerating potential varied from 1 Gv at sunspot minimum to 2.7 Gv during the magnetic storm July 15, 1959. During magnetic storms unisotropies of the acting electric field occur. This field lies at least mainly outside the radiation belt as is seen from the intensity records of moon rockets. (auth)

2061

GEOPHYSICAL EFFECTS OF THE TRAPPED PARTICLE LAYER. R. Jastrow (Goddard Space Center, National Aeronautics and Space Administration, Washington, D. C.). p.1009-18 of "Space Research. Proceedings of the First International Space Science Symposium, Nice, January 11-16, 1960." Hilde Kallmann Bijl, ed. Amsterdam, North-Holland Publishing Company and New York, Interscience Publishers, Inc., 1960. (In English)

Analyses by Jacchia and others suggested that the upper atmosphere is heated appreciably by ultraviolet radiation and particle streams emitted by the sun during periods of solar surface activity. Satellite measurements demonstrated that an appreciable part of the population of the trapped-particle regions is supplied by injection from solar streams into the outer atmosphere during periods of unusual solar activity. The rate of energy transfer from the trapped-particle population to the atmosphere was estimated and was great enough to produce substantial temperature increases, about 1000°, at altitudes of several hundred kilometers. Evidence was also obtained for a relation between the properties of the energetic-particle population and the generation of auroral displays. (auth)

2062

COSMIC RADIO WAVES. I. S. Shklovsky. Translated by Richard B. Rodman and Carlos M. Varsavsky. Cambridge, Mass., Harvard University Press, 1960. 453p. $12.50.

A comprehensive treatment is presented on radio waves emitted from objects located far beyond the solar system, and radio astronomy results are correlated with observations of optical astronomy. Among the topics discussed are receivers and antennas, observations on cosmic radio waves, galactic radio waves (continuous and monochromatic), origin of cosmic rays, and extragalactic radio waves. (D.L.C.)

Criticality Studies

2063 AERE-M-718

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

DENSITIES OF HYDROGEN AND URANIUM AND THEIR EFFECT UPON CRITICALITY. E. V. Garner and K. D. B. Johnson. July 1960. 10p. BIS.

The densities of hydrogen and uranium in crystalline solids and liquids which may occur during the processing of fissile materials are given. Criticality dependence upon density is discussed. (W.D.M.)

2064 HW-65552

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

SUMMARY LISTING OF SUBCRITICAL MEASUREMENTS OF HETEROGENEOUS WATER–URANIUM LATTICES MADE AT HANFORD. R. C. Lloyd. June 8, 1960. 53p. Contract W-31-109-eng-52. OTS.

A listing of all measurements on water–uranium heterogeneous lattices made at Hanford is presented. All lattices were water-moderated hexagonal arrays loaded with uranium enrichments up to 3.1%. (J.R.D.)

2065 LA-267

Los Alamos Scientific Lab., N. Mex.

MULTIPLICATION OF NEUTRONS IN SMALL SPHERES OF ACTIVE MATERIAL. C. Richman. Apr. 7, 1945. Decl. Aug. 2, 1960. 18p. OTS.

An experiment is described in which a source of neutrons is surrounded by a sphere of active material. The resulting counts when the sphere is in place and removed are compared. The ratio of the two rates is a measure of the reactive properties of the sphere. Results are compared with those obtained by other workers. (auth)

2066 UCRL-5369(Pt.2)

California. Univ., Livermore. Lawrence Radiation Lab.

CRITICAL MEASUREMENTS ON NEAR-HOMOGENEOUS, BeO-MODERATED, ORALLOY-FUELED SYSTEMS. Fred A. Kloverstrom and Donald E. Kraft. July 11, 1960. 18p. Contract W-7405-eng-48. OTS.

A series of BeO-moderated oralloy-fueled graphite-reflected reactors are described. Perturbations were introduced by inserting various materials into basic reactor configurations and observing their effect on the critical dimensions of the reactor. The reactors had fuel densities that corresponded to atomic BeO/U^{235} ratios of 247 and 493. (auth)

2067 WCAP-1412

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

MULTI-REGION REACTOR LATTICE STUDIES RESULTS OF CRITICAL EXPERIMENTS IN LOOSE LATTICES OF UO_2 RODS IN H_2O. V. E. Grob, P. W. Davison, D. F. Hanlen, R. D. Leamer, F. L. Kelly, and J. D. Cleary. Mar. 30, 1960. 53p. Contract AT(30-1)-2176. OTS.

The loose lattice experimental work performed under the Multi-Region Lattice Program conducted at the Westinghouse Reactor Evaluation Center is described. The fuel used in these experiments was the 2.73% enriched Yankee CRX fuel, described on page 14 of YAEC 94[1]. The purpose of the experiments was to obtain

critical mass information in the range of moderating ratios close to the optimum and to verify the physics computational methods now used for fuel storage calculations. The experimental program consisted of critical size, buckling, reflector savings, and microscopic parameter measurements. (auth)

2068 Y-801(Del.)
Oak Ridge National Lab., Y-12 Area, Tenn.
CRITICAL MASS STUDIES. PART VI. Dixon Callihan, D. F. Cronin, J. K. Fox, J. W. Morfitt, E. R. Rohrer, and D. V. P. Williams. Aug. 8, 1951. Decl. with deletions June 17, 1960. 32p. Contract W-7405-eng-26. OTS.

Data are presented on the conditions under which arrays of enhanced and natural uranium slugs of the Hanford type can be made critical with light-water moderator, and composite reflectors of water, lead, and natural uranium. An effort was made to determine the minimum number of enhanced slugs that could be made critical under such conditions, to establish the nuclear safety of a lead-lined shipping container, and to obtain a qualitative comparison of the relative reflecting ability of lead, water, methacrylate plastic, and natural uranium. (auth)

Elementary Particles and Radiations

2069 AFOSR-TN-60-680
Turin. Università.
SOME TOPICS IN POTENTIAL SCATTERING THEORY AND ITS HIGH ENERGY LIMIT. Technical (Final) Report. Mario Verde. Mar. 31, 1960. 26p. Contract AF61(052)-230.

A discussion is contained of potential scattering theory with the purpose of investigating the functional dependence of some analytic properties of the scattering amplitude from the corresponding ones of the potential. The case of fixed and real angular momentum is considered. An integral equation, which is a kind of dispersion relation's equation for the wave-function, forms the basis for deriving asymptotic expansions of phase-shifts valid for large values of the energy. The coefficients of these expansions are expressed as moments over the distribution of the singularities of the S or R matrices. The case of fixed and real energy is considered. A careful study was made on the nature and distribution of singularities of the scattering amplitude in the complex plane of angular momentum. The use of the so called Watson transformation leads to an asymptotic estimate of the total scattering amplitude for large values of cos θ, which is an important result needed for the derivation of the Mandelstarn representation in potential scattering. (auth)

2070 AFOSR-TN-60-1086
Trieste. Università. Istituto di Fisica.
ON THE TOTAL SPECIFIC IONIZATION. Scientific Note No. 1. P. Budini, L. Taffara, and C. Viola. July 12, 1960. 29p. Contract AF61(052)-211.

A method is given for calculating the absolute value of primary, secondary, and total specific ionization generated by an ionizing particle traversing a given medium. Density effect is taken into account. Numerical results are given for hydrogen and helium and compared with existing experimental data. It is shown that primary ionization yields a higher relativistic increase (lower density effect) than total ionization when the dilution of secondary ionization is felt. Further primary ionization in close collisions is independent of maximum transferable energy, which, on the contrary, influences appreciably ionization of higher generations. Simplified formulas are given for cases in which the influence of the physical characteristic of the medium on the phenomenon appears evident and which are likely to be compared with the experimental results. (auth)

2071 NP-9154
Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.
O PSEVDOVEKTORNOM TOKE V DEPTONNYKH RASPADAKH BARIONOV I MEZONOV. (On Pseudovector Currents in Leptonic Decay of Baryons and Mesons.) Kuang-chao Chou. 1960. 21p. (JINR-D-514).

The analytical properties of a certain matrix element were used in evaluating the R. P. Feynman et al. (The Axial Vector Current in β Decay, Preprint, 1960) analysis of the M. L. Goldberger et al. (Phys. Rev., 110: 1178, 1958) calculations of $\pi \rightarrow \mu + \gamma$ decay probability. It is shown that the Goldberger and Treiman results hold for strong interactions and for ordinary pseudoscalar bonding. A formula was derived for experimentally verifying the postulated assumptions. Analogous leptonic decays of hyperons and K mesons are discussed. (R.V.J.)

2072 NP-9166(p.1-14)
Saha Inst. of Nuclear Physics, Calcutta.
PARITY-VIOLATION IN LOW-ENERGY NUCLEAR PHYSICS. P. K. Kabir.

A treatment is given of parity nonconservation with particular reference to β decay. Experiments on β decay in the past 3 years since Lee and Yang's discovery of parity nonconservation have been successfully correlated in a simple form of Fermi's theory, and the mathematical basis is derived for this theory. It is concluded that the state of β-decay theory is now in a better condition than it was before the discovery of parity nonconservation. (D.L.C.)

2073 NP-9166(p.21-5)
Tata Inst. of Fundamental Research, Bombay.
K^+-NUCLEON SCATTERING AND THE QUESTION OF RELATIVE K^+-Y PARITY. S. N. Biswas and L. K. Pandit.

The scattering of mesons (K^+) by nucleons is calculated for both even and odd relative (K^+-Y) parity using Fredholm's method. The cross section for even parity is in agreement with the experimental energy dependence. However, the angular dependence, isotropic in the range 50 to 150 Mev, and the K^+-p interaction do not yet indicate any preference for either parity, and further work is necessary. (D.L.C.)

2074 NP-9166(p.26-7)
Calcutta. Univ. Presidency Coll.
ON A RIGOROUS EXPERIMENTAL TEST ON THE CONSERVATION OF HEAVY PARTICLE NUMBER FOR FREE NUCLEON. P. K. Sen Chaudhury.

A possible rigorous experimental proof which can be carried out on the conservation of heavy particle number of free nucleons in weak interactions is pointed out. The proof is based on an alternative mode of neutron decay $n \rightarrow \bar{p} + \beta^+ + \nu$, which is just as energetically possible as $n \rightarrow p^+ + \beta^- + \nu$, but which is forbidden by the conservation of the heavy particle number. A search can be made for mesons created by antiproton annihilations in reactor neutron fluxes. (D.L.C.)

2075 NP-9166(p.183-7)
India. Atomic Energy Establishment, Trombay.
POLARIZED PROTON BEAMS AT LOW ENERGIES. A. S. Divatia.

The problems and methods involved in producing polarized protons of low energy (< 10 Mev) are treated: the

molecular beam method, the quadrupole magnet method, and the Lamb shift method. It is concluded that the main problems are locating a polarized proton source inside the dome of a Van de Graaff accelerator and obtaining enough power to operate the source. (D.L.C.)

2076 NP-9166(p.201-6)

Bose Research Inst., Calcutta. Nuclear Physics Lab.
ABSOLUTE MEASUREMENT OF ATOMIC ABSORPTION CROSS SECTION OF LEAD FOR Co^{60} PHOTONS. A. M. Ghose.

The photoelectric cross section or the atomic-absorption cross section of photons in lead was determined using the spherical symmetry method, which consists in measuring the transmission of Co^{60} γ radiations (1.1728 and 1.3325 Mev) through lead hemispherical shells of lead foils. Multiple scattering and energy degeneracy of photons were corrected. The data indicate a total absorption cross section of 4.32 ± 0.73 barns which, when corrected for pair production (0.14 barns), gives an atomic-absorption cross section of 4.18 ± 0.73 barns. Data on γ transmission through water are also given. (D.L.C.)

2077 NP-9260

Dublin Inst. for Advanced Studies.
IDENTITIES BETWEEN STRONG AND WEAK INTERACTIONS. H. Shimodaira and Y. Takahashi. [1960]. 13p.

Models of the axial vector weak interaction proposed by Gell-Mann and Lévy are investigated. The condition

$$P^{\alpha}_{\mu_0 i}(x) = i\dot{\pi}^{\alpha}(x),$$

on the weak axial vector, under which the identity

$$-G_A/G = \frac{\mu_0^2}{m_\pi^2}\sqrt{Z_3}\frac{f_1}{f_0}d_\pi(0)\ F_\pi(0)$$

holds, is somewhat weakened. The pion decay process into leptons is discussed by introducing the direct coupling between them, in addition to the four-fermion interaction. It is pointed out that the presence of the direct coupling between pion and leptons does not alter the above relation for the ratio G_A/G, its value being independent also of the constant for direct coupling. (auth)

2078 TID-6537

Midwestern Universities Research Assn., Madison, Wis.
1959 MURA SUMMER STUDY REPORTS ON DESIGN AND UTILIZATION OF HIGH-ENERGY ACCELERATORS. 213p. Contract AT(11-1)-384. OTS.

Contains MURA Reports 460, 462, 465, 467, 468, 469, 470, 471, 472, 473, 475, 478, 479, 506, 576, and 499. Report 499 was abstracted separately as NSA 14-1004.

A discussion is given of some of the properties of elementary particles and their interactions. It is pointed out that experiments with high-energy high-intensity accelerators can shed further light on these properties. A list is given of new hypothetical elementary particles that might be looked for with these accelerators. (auth)

2079 TID-6646

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.
INPUT-OUTPUT MODIFICATIONS OF GAMMA HEATING PROGRAM 0307 FOR A FINITE HETEROGENEOUS CYLINDER. M. R. Smith. July 13, 1960. 16p. Contracts AF33(600)-38062 and AT(11-1)-171. (XDC-60-9-19). OTS.

The data input and output format for the Finite Heterogeneous Cylinder Gamma Heating Program 307 was revised in order to simplify the data input detail and to provide the user with optional output units. The modifications are described and the procedure for using the revised program is outlined. Input sheets were prepared for data input specifications. (auth)

2080 CEA-tr-R-878

LONGUEUR DE RALENTISSEMENT DES NEUTRONS. (Neutron Slowing-Down Length). V. P. Kochergin (Kocherguine) and V. V. Orlov. Translated into French by [B.] Vinogradoff from Atomnaya Energ. 6, 34-41(1959). 17p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract No. 18273.

2081

DECAY OF $\Lambda_0 \rightarrow n + \gamma$ THROUGH NON LOCAL FERMI INTERACTIONS DUE TO VECTOR MESONS. J. L. Acioli (Centro Brasileiro de Pesquisas Físicas Rio de Janeiro and Faculdade Nacional de Filosofia, Rio de Janeiro). Anais acad. brasil. cienc. 32, 9-16(1960). (In English)

The decay of $\Lambda_0 \rightarrow n + \gamma$ through non-local Fermi interactions due to vector mesons is calculated. It is found that the branching ratio of $\Lambda_0 \rightarrow n + \gamma$ with respect to the pionic decay mode $\Lambda_0 \rightarrow n + \pi_0$ can be of the order of 5×10^{-4}. (auth)

2082

A USEFUL APPROXIMATION IN THE THEORY OF RESONANCE ABSORPTION. A. Keane and M. H. McKay (Univ. of New South Wales, Kensington). Australian J. Appl. Sci. 2, 321-8(1960) Sept.

An approximation first introduced at the 1955 Geneva Conference by Gurevich and Pomeranchouk is investigated and shown to be a useful means of supplementing tables presented recently by Cook and Elliott (1960). (auth)

2083

STOCHASTIC STUDY OF THE DISTRIBUTION OF NEUTRONS IN A MODERATOR. G. Louchard (Université Libre, Brussels). Bull. classe. sci., Acad. roy. Belg. (5) 46, 233-49(1960). (In French)

The distribution of neutrons in a moderator is treated as a stochastic process. The general equations for this process are given, and the physical properties and conditions are summarized. The total number of neutrons, with or without fission, is studied. Differential equations are obtained and solved for the characteristic function and the moments of the distribution. (auth)

2084

CONSIDERATIONS ON A MESON-ATOMIC MODEL OF THE NUCLEON. L. E. H. Trainor (Univ. of Alberta, Edmonton). Can. J. Phys. 38, 1245-55(1960) Oct.

A model of the nucleon is described in which a π meson moves about a nucleon core under the action of a hyper-Maxwell field. On such a model, the short range of the internucleon force appears as a screening effect. Despite its obvious limitations, the model does possess some features that lead to results in agreement with experiment. The advantage of such models is that they may provide insight into problems that are difficult from the usual field theory point of view. In particular, one might hope to obtain some understanding of the state of the π meson field in the nuclear many-body problem. (auth)

2085

SLOWING DOWN OF FAST NEUTRONS IN WATER. Kazuaki Nishimura and Michio Maruyama (Japan Atomic Energy Research Inst., Tokyo). J. Atomic Energy Soc. Japan 2, 542-50(1960) Sept. (In Japanese)

The migration area of thermal neutrons and the age of indium-resonance neutrons in water were obtained with T-D neutrons. Taking into account the angular dependence of the emitted neutron energy and yield in the T-D reaction,

the average source energy was taken to be 14.2 Mev. By means of the "cadmium difference" method and a small (13 mmϕ × 50 mm) BF_3 counter, the spatial distribution of thermal neutrons in a large water tank was measured at the 0, ±45, and ±80° directions along the radial distance from the source to the point of 110 cm; then, the migration area M^2 was obtained from the spatial distribution of thermal neutrons in each direction. The spatial distribution of indium-resonance neutrons also was measured by indium foils with cadmium covers to the point of 55 cm at the same directions. The neutron age τ_{in} of indium-resonance energy (1.44 ev) was obtained, using the same relaxation length in large distances as the thermal neutron distribution. The values of migration area M^2 and neutron age τ_{in} were determined to be 176 ± 5 cm^2 and 167 ± 8 cm^2, respectively. The slowing down length $L_s = (\tau_{in}{}^{1/2})$ to indium-resonance energy is 12.9 ± 0.3 cm, which is in agreement with Volkin's curve, which was calculated assuming the anisotropic nature of the elastic scattering by oxygen. (auth)

2086

ON THE RADIATION EMITTED BY AN ACCELERATED POINT CHARGE. A. Schild (Univ. of Texas, Austin). J. Math. Anal. and Appls. 1, 127-31(1960) June.

A proposal is given for a clear and complete argument for the relativistic character of the energy and momentum radiated by a single accelerated point charge. An equation is derived for a point charge moving along the world line L through a finite interval QQ′ confined to the space time region between the two future null cones Σ and Σ' with vertices at Q and Q′. For this finite interval the total radiation is $P^\mu = -\frac{2}{3} e^2 \int_Q^{Q'} \dot{z}_\alpha \ddot{z}^\alpha dz^\mu$. (B.O.G.)

2087

REACTION MATRIX SINGULARITIES AND THE ENERGY GAP IN AN INFINITE SYSTEM OF FERMIONS. V. J. Emery (Univ. of California, Berkeley). Nuclear Phys. 19, 154-63(1960) Oct. (1). (In English)

It is shown that the presence of a singularity in Brueckner's t-matrix for an infinite system of Fermions is a sufficient (but not necessary) condition for the existence of a gap in the energy spectrum of the system. On the other hand there are singularities in Galitskii's t-matrix if and only if the system has an energy gap. Furthermore there are both singularities and an energy gap if the solution of a Schrödinger equation with modified kinetic energy has a positive phase shift δ at the Fermi momentum. The results are illustrated by deriving approximate expressions for the energy gap and the distances of the singularities from the Fermi surface in terms of the phase shift δ. (auth)

2088

A NOTE ON THE PERTURBATION METHOD IN NEUTRON TRANSPORT THEORY. G. Rakavy (Hebrew Univ., Jerusalem). Nuclear Sci. and Eng. 8, 281-2(1960) Sept.

The perturbation formula of neutron transport theory is derived with the method of ordinary perturbation theory used in quantum mechanics, whereby the Boltzmann equation is transformed into a new form. Any number of terms in the perturbation series may be equated to zero. (D.L.C.)

2089

NEUTRON RETHERMALIZATION CROSS SECTION MEASUREMENTS IN GRAPHITE. R. A. Bennett and R. E. Heineman (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. 8, 294-9(1960) Oct.

The thermal neutron absorption rate in "1/v" materials was observed near a discontinuity in the temperature of a graphite moderator. A plausible group diffusion model of the space and energy distributions of the thermal neutrons was assumed. The experimental data were used to obtain the transfer cross sections, called rethermalization cross sections, to be used with this model. The cross sections obtained for crystalline graphite were small compared to those expected for gaseous graphite; but they increased by a factor of about seven, from (1.9 ± 0.05) × 10^{-3} to (14.5 ± 2.6) × 10^{-3} cm^{-1}, from the lowest temperature of 108°K to the highest temperature of 666°K. (auth)

2090

THERMAL NEUTRON FLUX DEPRESSION BY ABSORBING FOILS. R. H. Ritchie and H. B. Eldridge (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 8, 300-11 (1960) Oct.

The perturbation of a thermal neutron flux field by an absorbing foil is considered for the case of a foil of thickness t and of lateral dimensions ≫L, where L is the diffusion length of thermal neutrons in the medium. The integral equation for one-velocity transport of neutrons in the medium containing the foil is solved by a variational method in which the eigenvalue is closely related to the foil activation. The results are compared with the predictions of the Bothe and Skyrme theories. The Bothe and Skyrme theories are compared for the case of the finite disk-shaped foil and are shown to differ primarily in the transport correction. This difference may be important in cases where L is not very large compared with the mean free path of neutrons in the medium. On the basis of these considerations, a new analytic approximation for the activation of a finite foil is proposed. (auth)

2091

GENERALIZED RESONANCE INTEGRAL REPRESENTATION. Melvin M. Levine (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 8, 363-4(1960) Oct.

In a study of neutron spectrum effects in resonances, the approximations of Chernick and Vernon and Dresner for Narrow Resonance and Narrow Resonance Infinite Absorber were investigated. It appeared likely that the lack of agreement between measurements in lattices and in single lumps is due only partly to deficiency of the present reduction scheme. (M.C.G.)

2092

ON THE SCATTERING OF THERMAL NEUTRONS IN THE HYDROGEN CONTAINING MOLECULES. Jerzy A. Janik, Janina Janik, Szczęsny Krašnicki, Franciszek Maniawski, Andrzej Murasik, Henryk Rżany, Antoni Szkatuła, Jan Ściesiński, and Adam Wanic (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 495-500(1960). (In German)

Results are reported for the following problems: the verification of the theory of neutron scattering by molecules of molecular gases; the examination of the structure of liquids by investigation of experimental deviations of the scattering cross sections from the theory; neutron scattering by polarized molecules; and neutron scattering by molecules that possess a vibrational energy level in the thermal energy region. (auth)

2093

ON THE SYMMETRIES OF STRONG AND WEAK INTERACTIONS. F. Gürsey (Brookhaven National Lab., Upton, N. Y.). Nuovo cimento (10) 16, 230-40(1960) Apr. 16. (In English)

A model of strong interactions is proposed which admits a group (G_4 × H) in the limit of a suitably defined doublet approximation, G_4 being a 4-dimensional extension of the isotopic spin group and H the hypercharge gage group. Weak interactions having phenomenological chirality invariance properties or obeying the $\Delta I = \frac{1}{2}$ rule are shown

to be invariant under a unitary subgroup of the group ($G_4 \times H$). (auth)

2094

EMISSION OF HYPERFRAGMENTS IN CAPTURE STARS OF NEGATIVE HYPERONS AT REST. G. Dascola, C. Lamborizio, S. Mora, and I. Ortalli (Università, Parma, Italy). Nuovo cimento (10) 16, 241-6(1960) Apr. 16. (In English)

Five hyperfragments, emitted from a total of 137 Σ^--stars at rest, were observed. The estimate of the emission probability of such events is $(1.2 \pm 0.5)\%$, somewhat lower than the similar estimate for the hyperfragments from the K^--stars at rest observed in the same stack $(3.4 \pm 0.6)\%$. (auth)

2095

A TECHNIQUE FOR ELIMINATING THE VARIATION OF MASS WITH VELOCITY IN RELATIVISTIC PROBLEMS. S. Tyagaraja Rao (Univ. of Madras). Nuovo cimento (10) 16, 274-82(1960) Apr. 16. (In English)

The solution of problems involving the relativistic change of mass with velocity is facilitated by the introduction of a new temporal parameter τ. When this parameter is used instead of t, the effective mass of the particle becomes a constant. The equation of motion of a relativistic particle in a given e.m. field is obtained using this formulation. This leads to a simple derivation of Sommerfeld's fine-structure formula, correct up to second order in α. (auth)

2096

NOTE ON DIVERGENCELESS CURRENTS AND MUON POLARIZATION IN $K_{\mu 3}$ DECAYS. S. Hatsukade, R. E. Marshak, S. Okubo, and E. C. G. Sudarshan (Univ. of Rochester, N. Y.). Nuovo cimento (10) 16, 332-41(1960) Apr. 16. (In English)

The hypothesis of conserved current in weak interaction is examined for strangeness nonconserving decays. This hypothesis enables the unambiguous calculation of the longitudinal polarization of a muon in $K_{\mu 3}$ decay as a function of the pion energy. Its dependence on the muon energy is studied. The result is compared with that of Okun and Martinyan who did not use a conserved current. (auth)

2097

THE BINDING ENERGY OF Λ-PARTICLES IN NUCLEAR MATTER. J. D. Walecka (Stanford Univ., Calif.). Nuovo cimento (10) 16, 342-9(1960) Apr. 16. (In English)

From an analysis of the existing data on the binding energy of Λ particles in hyperfragments a fairly reliable value of the binding energy of Λ particles in nuclear matter can be obtained. This value is $V_0 \approx 22$ Mev. It is proposed that this number gives an independent check on the validity of potentials deduced from the very light hyperfragments. Some simple calculations using the techniques of Brueckner et al. are carried out with the potential of Lichtenberg and Kovacs (which contains a hard core). It is found that if only s wave interactions are considered one finds good agreement with the above number. If higher partial waves are included one obtains far too much binding energy and it is suggested that the Λ-nucleon interaction may be weakened by an exchange force in these states. (auth)

2098

ON THE ORIGIN OF SUPER-SELECTION RULES. S. T. Epstein (Univ. of Nebraska, Lincoln). Nuovo cimento (10) 16, 362-4(1960) Apr. 16. (In English)

It is shown that all the usually assumed super-selection rules follow from the fact that in any experiment one starts with definite numbers of each kind of particle. (auth)

2099

ON THE HIGH ENERGY BEHAVIOR IN FIELD THEORY. E. Kazes (Pennsylvania State Univ., University Park). Nuovo cimento (10) 16, 368-9(1960) Apr. 16. (In English)

The high energy behavior of cross sections and vertices is of great interest in dispersion theory and bears heavily on the consistency problem of field theory. Using the method of Lehmann et al., it is shown that the $\pi \rightarrow N + \bar{N} + \pi$ vertex cannot go to the Born approximation result in the limit of infinite invariant momentum transfer. These conclusions are validated by those of Aramaki, and Källén for a meson propagator and an effective coupling constant. (B.O.G.)

2100

RADIATIVE CORRECTIONS TO THE e-e SCATTERING. Yung Su Tsai (Stanford Univ., Calif.). Nuovo cimento (10) 16, 370-2(1960) Apr. 16. (In English)

The radiative corrections to the e-e clashing beam experiment are calculated. The experiment is conducted using two intersecting 500-Mev electron beams and Cherenkov counters as detectors for the scattered electrons. The experiment is in progress and is designed to test the validity of quantum electrodynamics at small distances, or to find if the electron has any finite size (form factor) down to $\sim 0.5 \times 10^{-14}$ cm. The elastic parts of the radiative corrections to order α^3 are calculated using a high-energy approximation. The results from this approximation have confirmed the results of Redhead and Polovin for the elastic parts. (B.O.G.)

2101

PION RESONANCES. J. J. Sakurai (Univ. of Chicago). Nuovo cimento (10) 16, 388-91(1960) Apr. 16. (In English)

A discussion is presented concerning possible resonances in two- and three-pion systems. Frazer and Fulco showed that a two-pion resonance in T = 1, J = 1 can account for the large isovector moment of the nucleon. It is expected that this resonance would be helpful not only in understanding the isovector part of the nucleon structure but in attacking the two-pion contribution in N–N and π–N scattering. Considerations are given which rule out a repulsive core in the $N-\bar{N}$ case, resulting in the conclusion that the repulsive core in the N–N case is due to a three-pion state. The view is expressed that there exists a three-pion resonance in T = 0, J = 1, which throws light on the isoscalar part of nucleon structure. Recently, a theory of strong interactions was proposed which unambiguously predicts the existence of one two-pion resonance in T = 1, J = 1 and two three-pion resonances both in T = 0, J = 1. Since a three-pion resonance was proposed by Chew, the variations of the Chew theory and the vector theory of strong interactions are emphasized. (B.O.G.)

2102

PRODUCTION AND DECAY OF $\overline{\Sigma^+}$. E. Amaldi, A. Barbaro-Galtieri, G. Baroni, C. Castagnoli, M. Ferro-Luzzi, A. Manfredini, M. Muchnik, V. Rossi, and M. Severi (Istituto Nazionale di Fisica Nucleare, Rome and Università, Rome). Nuovo cimento (10) 16, 392-5(1960) Apr. 16. (In English)

A search was conducted for $\overline{\Sigma^+}$ by exposing emulsion stacks to antiproton beams. The results presented came from exposures to 2.05 Bev/c purified $\bar{p}$ beams. A schematic illustration is given of the event observed during the scanning of the stacks, and an interpretation is given of the evidence suggested by the observed event. The features of the two stars within the event are tabulated. A discussion is included of an interpretation which avoids the assumption of the existence of an antihyperon. However, it is concluded that the interpretation does not avoid the assumption of the antihyperon existence nor the difficulties con-

nected with the measured mass values and with the assumption of an inelastic scattering in which a part of the incident kinetic energy disappears without any visible energy. (B.O.G.)

2103

ANGULAR DISTRIBUTIONS. E. Lubkin (Univ. of California, Berkeley). Nuovo cimento (10) 16, 1098-1108(1960) June 16. (In English)

The theorem for distributions in the angles θ, φ is extended to the third Euler angle, Ψ, whereupon it becomes equivalent to the rotational invariance of the responsible interactions. An interpretation of half-angle terms in the general rate formula is given. (auth)

2104

A METHOD FOR TRAPPING MUONS IN MAGNETIC FIELDS, AND ITS APPLICATION TO A REDETERMINATION OF THE EDM OF THE MUON. G. Charpak, L. M. Lederman, J. C. Sens, and A. Zichichi (European Organization for Nuclear Research, Geneva). Nuovo cimento (10) 17, 288-303(1960) Aug. 1. (In English)

A method for trapping muons in magnetic fields is described together with its application to higher accuracy determination of the electric dipole moment of the muon. The value found is EDM $\leq e(5 \pm 5) \times 10^{-17}$ cm, which is consistent with time reversal invariance. (auth)

2105

POLARIZATION PHENOMENA FOR POSITRON ANNIHILATION-IN-FLIGHT. W. H. McMaster (Univ. of California, Livermore). Nuovo cimento (10) 17, 395-414(1960) Aug. 1. (In English)

A method is presented for solving the Dirac equation for the annihilation of positrons by the use of the Pauli spinors in such a way that all the polarization features are retained. Several specific examples of the polarization features are discussed, and the annihilation equation is put into matrix form for use with the Stokes parameters. This later representation is particularly convenient in that it readily points out the general features of the annihilation process. (auth)

2106

ON THE PHOTONIC DECAY OF THE HYPERONS. L. Tenaglia (Università, Bari, Italy). Nuovo cimento (10) 17, 423-8(1960) Aug. 1. (In English)

The matrix element is evaluated for the photonic decay of the hyperons and is given as a function of the matrix element for the pion-photoproduction by nucleons. The results obtained (namely, the branching ratio between photonic and pionic decay of the hyperons) agree with the few experimental data known at present. (auth)

2107

EFFECT OF LEPTON NON-CONSERVATION ON π-DECAY, P. K. Kabir (Univ. of Calcutta). Nuovo cimento (10) 17, 438-41(1960) Aug. 1. (In English)

The branching ratio R of $\pi^+ - e^+$ to $\pi^+ - \mu^+$ decays is shown to be a sensitive test for the presence of the Fermi A type of lepton-nonconserving interaction. For lepton conservation and equal coupling constants for β decay and μ absorption, R is calculated to be $R_0 = 1.28 \times 10^{-4}$ for the A case, which is in excellent agreement with the experimental value of 1×10^{-4} observed by Anderson et al. If a small lepton-nonconserving interaction strength $\epsilon = D^2/C^2$ is present, $R = (1 + N\epsilon)R_0$, where $N = 7.45 \times 10^4$; thus an admixture of 10^{-5} of lepton-nonconserving A interaction would almost double R, and it is concluded that any such admixture must be considerably smaller or nonexistent. (D.L.C.)

2108

HIGH-ENERGY PION-NUCLEON COLLISIONS AND ISOTOPIC PROPERTIES OF THE PION-PION INTERACTION. A. Krzywicki (Inst. for Nuclear Research, Warsaw). Nuovo cimento (10) 17, 442-5(1960) Aug. 1. (In English)

The results of an investigation of high-energy (>4 Bev) pion-nucleon interactions are briefly described together with a detailed list of the assumptions made. Only peripheral pion-nucleon collisions with strong pion-pion interactions are considered. The problem of obtaining the branching ratio R of $\pi^- + p \rightarrow \pi^0 + \pi^- + p$ to $\pi^- + p \rightarrow \pi^+ + \pi^- + n$ from the experimental branching ratio R_{exp} is treated. For Walker's data at 4.5 Bev, R_{exp}/R is calculated to be ~4, and for various pion-pion scattering amplitudes, R is calculated and tabulated with the isotopic spins. For the process $\pi^- + p \rightarrow \pi^- + \pi^- + \pi^+ + p$ occurring in a bubble chamber, the relative frequency of occurrence of stars with slow backward pions being positive or negative is calculated for seven extreme cases, and the $\sigma(\pi^- p \rightarrow 2\pi^- \pi^+ p)$ is shown to be on the order or somewhat smaller than $\sigma(\pi^- p \rightarrow \pi^- \pi^+ n)$ (1 mb) for 4.5 Bev. (D.L.C.)

2109

THEORETICAL ANALYSIS OF ABSORPTION OF SLOW π^--MESONS IN LIGHT NUCLEI. P. Ammiraju and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 17, 726-33(1960) Sept. 1. (In English)

An analysis of the π^--absorption in light nuclei is presented assuming that the absorption reaction proceeds via the two nucleon π^--capture mode viz., through the reaction $\pi^- + (N + N^0) \rightarrow N^0 + N^0$. Assuming the charge independence of pion-nucleon interaction and unitarity and time-reversal invariance of the S-matrix, the two nucleon π^--capture reaction cross sections are written in terms of the nucleon-nucleon phase shifts. The parameters that enter into the theory are determined from the experimental observation of Ozaki et al. Using the principle of detailed balance, a check is made of the parameters with meson production data at threshold. It is further shown that the two-nucleon model provides a consistent explanation of the absorption phenomena of the π^--meson in helium and carbon. (auth)

2110

TEST OF GLOBAL SYMMETRY FROM MULTINUCLEON K^--CAPTURE. S. S. Saxena (Atomic Energy Establishment, Trombay, India) and S. N. Biswas. Nuovo cimento (10) 17, 749-56(1960) Sept. 1. (In English)

The principle of charge-independence coupled with the unitarity and time-reversibility of the scattering matrix enables one to express the production amplitude of the K^--capture reactions in terms of the scattering phases of the final state interaction. By making impulse type approximation, certain relations between $K^- + d$ and $K^- + 2N$ absorption cross sections are obtained. The experimental data are analyzed on the basis of the global symmetry of strong interactions. It is found that within the limits of this approximation the symmetry is incompatible with the experimental observations. (auth)

2111

ON THE DECAY RATE OF THE CHARGED PION. J. Bernstein (Faculté des Sciences, Orsay, France), S. Fubini, M. Gell-Mann, and W. Thirring. Nuovo cimento (10) 17, 757-66(1960) Sept. 1. (In English)

The Goldberger-Treiman relation between the pion decay amplitude and the axial vector coupling constant in β decay is shown to be plausible if the divergence of the axial vector current is a highly nonsingular operator (i.e., one that emphasizes low frequencies). Such a situation is

probably realized in a renormalizable theory for which this operator is proportional to the conventional pion field. Some other possible consequences of the low-frequency character of the operator are mentioned. (auth)

2112

FORM-FACTOR OF THE NEUTRON FROM DEUTERON ELECTRO-DISINTEGRATION. S. K. Bose (Univ. of Rochester, N. Y.). Nuovo cimento (10) 17, 767-74(1960) Sept. 1. (In English)

An extrapolation method is suggested to determine the magnetic form-factor of the neutron from deuteron electrodisintegration. (auth)

2113

ELECTROPRODUCTION OF π-MESONS. R. Blankenbecler (Princeton Univ., N. J.), S. Gartenhaus, R. Huff, and Y. Nambu. Nuovo cimento (10) 17, 775-85(1960) Sept. 1. (In English)

An approximate evaluation is made of the dispersion relations for the production of pions in electron-nucleon collisions. The results are applicable at low energies in the final pion-nucleon barycentric system where the assumption that the (3, 3) state dominates the dispersion integrals is expected to be valid. Effects due to nuclear recoil and crossing symmetry are treated to all orders. (auth)

2114

INTERACTIONS OF 1.15 GeV/c K^--MESONS IN EMULSION. [PART] I. C. M. Garelli, B. Quassiati, and M. Vigone (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10) 17, 786-801(1960) Sept. 1. (In English)

Reported are the results of an analysis of 1675 interactions of high energy K^--mesons with the emulsion nuclei. The main results concern the emission of charged hyperons, their energy and angular distribution, the ratio (Σ^- emitted)/(Σ^+ emitted); an estimate is given of the probability of Σ inelastic reemission. (auth)

2115

REMARKS ON COMPOUND MODELS, CONSERVED CURRENTS AND WEAK INTERACTIONS. M. E. Mayer (C. I. Prahon Univ., Bucharest). Nuovo cimento (10) 17, 802-3 (1960) Sept. 1. (In English)

A discussion is given of some implications of a symmetry principle, conjectured by Gamba, Marshak, and Okubo (GMO), in connection with the compound models for elementary particles, and the interpretation of weak interactions by a heavy vector meson coupled to the conserved V and A currents of the fermions. GMO observed that, for weak interactions, the three baryons Λ°, n, p are equivalent to the leptons μ^-, e^-, ν in the sense that any reaction permitted or observed for one of the groups is permitted for the other and conversely, no reaction forbidden for one is observed in the other. This permitted the extension of the notions of isospin and strangeness to leptons and led to the expression of the electric charge in terms of the isospin projection, T_3, and the baryon and lepton numbers B and L: $Q = T_3 + \frac{1}{2}(S + B - L)$. (B.O.G.)

2116

Σ^- PRODUCTION IN EMULSION BY 1.1 GeV/c K^- MESONS. M. Baldo Ceolin, A. Caforio, O. Fabbri, F. Farini, A. Ferilli, G. Miari, and J. Schneps (Università, Bari, Italy; Università, Padua; and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10) 17, 804-6(1960) Sept. 1. (In English)

An investigation was undertaken to verify the reaction: $K^- + N \rightarrow \Sigma^- + K^{+,0}$, and to study the production frequency of Σ^- particles. A stack of G-5 emulsions was exposed to K^- mesons of 1.1 Bev/c momentum. The 225 stars found along the tracks were analyzed for K^--nucleon interactions. The results of the analysis are discussed. (B.O.G.)

2117

DOUBLE PION PHOTOPRODUCTION. M. Feldman, V. Highland, J. W. DeWire, and R. M. Littauer (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters 5, 435-7(1960) Nov. 1.

The possible reactions for the photoproduction of two pions from hydrogen are (1) $\gamma + p \rightarrow p + \pi^0 + \pi^0$, (2) $\gamma + p \rightarrow p + \pi^+ + \pi^-$, and (3) $\gamma + p \rightarrow n + \pi^+ + \pi^0$. These reactions are of interest for the study of the isobar model, π-nucleon forces, and π-π forces. The Cornell synchrotron bremsstrahlung beam was used to observe (1) and (3) by detecting the two π's in coincidence. A photon from the decay of a π^0 enters the totally absorbing lead glass Cherenkov counter, producing a pulse proportional to its energy. A diagram is given of the experimental arrangement showing the incident γ-ray beam and the Cherenkov counter. The results are given in graphical and tabular form. Reaction (1) seems to be isotropic while reaction (3) shows a strong forward peaking of π^+, particularly for forward π^0 angles. (B.O.G.)

2118

EXTRAPOLATION METHOD TO DETERMINE DIFFERENTIAL SCATTERING CROSS SECTIONS OF UNSTABLE PARTICLES. Michael Nauenberg (Univ. of California, Berkeley). Phys. Rev. Letters 5, 438-9(1960) Nov. 1.

The method consists of extrapolating the cross section for a related but measurable reaction as a function of one of the invariant momentum transfers to a pole of the S matrix for the reaction. Its success depends on the location and strength of other less well-known singularities of the S matrix. The existence of two branch points appearing in the Chew-Low prescription for the differential cross section of the unstable particle is pointed out. These branch points result from the constraint of fixed scattering angle, and disappear only when the integration over the angle to obtain total cross sections is carried out. A modification of the extrapolation method is given which tends to avoid this difficulty. (B.O.G.)

2119

P-WAVE PHASE SHIFTS AT 210 Mev AND THE PHOTODISINTEGRATION OF THE DEUTERON. Gustav Kramer (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters 5, 439-41(1960) Nov. 1.

Recently it was shown that the cross section for photodisintegration of deuterons can give useful information about the nuclear force in the ^3P state if certain assumptions are made: (1) the ground-state wave function is known; (2) the electric dipole process, $^3S_1 + {}^3D_1 \rightarrow {}^3P_0$, $^3P_1$, $^3P_2 + {}^3F_2$, is dominant; and (3) virtual meson effects can be neglected. Four sets of phase shifts (A, B, C, and D) were obtained when MacGregor et al., applied the modified phase-shift analysis program to the Rochester p-p scattering data at 210 Mev. The A and D solutions were excluded because neither corresponds to an acceptable phase-shift solution at 310 Mev. Depolarization parameter data show that the A and D solutions are excluded by measurements at 210 Mev alone and indicate a preference for solution B over C. MacGregor's values are tabulated for phase shifts of the sets A, B, C, and D converted to phase shifts as defined by Blatt and Biedenharn. The experimental data for γ energies of 60 to 150 Mev are shown graphically. The values predicted for the total cross section, σ_t, for the four sets are 26 μb, 48 μb, 41 μb, and 36 μb, respectively, whereas the measured value at

E_γ = 105 Mev is (60 ± 10) μb. This shows that the dipole process yields the largest contribution for all sets of phase shifts. The smaller contribution for A, C, and D compared to the value for B indicates a further preference for set B. (B.O.G.)

2120

DETERMINATION OF THE RELATIVE Σ-Λ PARITY AND OF THE RATIO OF ASYMMETRY COEFFICIENTS α_Λ TO α_0 IN HYPERON DECAY FROM THE PION-HYPERON RESONANCE. Ph. Meyer, J. Prentki, and Y. Yamaguchi (European Organization for Nuclear Research, Geneva). Phys. Rev. Letters 5, 442-3(1960) Nov. 1.

Experiments are proposed for the determination of the relative Σ-Λ parity and the ratio of asymmetry coefficients α_Λ (in $\Lambda \rightarrow p + \pi^-$) to α_0 (in $\Sigma^+ \rightarrow p + \pi^0$) by measuring only up/down asymmetries. The proposals depend on the following assumptions: (1) the isobar Y* is a "good" resonance, meaning that it is reasonably narrow and pronounced so that experimental conditions can be chosen under which the resonant process dominates; and (2) in the "decay" of Y* the branching ratio (b)/(a) = (c)/(a) is not too small. Preliminary experiments seem to indicate that these assumptions are reasonable. Whatever the situation turns out to be, the experimental investigation of the considered reaction will give useful information on the position, width, and spin of the resonance, and can shed light on the understanding of strange particle interactions. (B.O.G.)

2121

ELEMENTARY PARTICLES. T. D. Lee (Columbia Univ., New York). Phys. Today 13, No. 10, 30-6(1960) Oct.

The history of particle physics from 1897, the discovery of the electron, to the present is related. Discussions are included on associated production and conservation of strangeness; experimental developments since 1953; right-left asymmetry or nonconservation of parity; two-component theory of neutrinos; particle-antiparticle asymmetry; and universal character of weak interactions. (B.O.G.)

2122

A MODEL FOR HYPERFRAGMENTS. E. C. G. Sudarshan and S. Iwao (Univ. of Rochester, N. Y.). Proc. Indian Acad. Sci., Sec. A 52, 27-34(1960) July. (In English)

A method of analysis relating the binding energies to the matrix elements of the A-nucleon interaction is developed using a model of hyperfragments patterned after the model of complex nuclei. The physical postulates are that the system is represented well by an antisymmetrized product of one-particle wave functions with two-particle interactions and j-j coupling. The cases considered are restricted to hyperfragments with unexcited nucleon states, and the projection theorem is used in the calculations. For the four known S-shell hyperfragments, the following parameters for the Λ binding energies are derived: the one-particle energy of the hyperon and the singlet and triplet matrix of the nucleon-Λ interaction for the configuration $S_{\frac{1}{2}} S_{\frac{1}{2}}$. The results indicate antiparallel configuration of the hyperon spin and the spin of the nucleon group, zero spin for $_\Lambda He^4$, and no bound excited states for any S-shell hyperfragment. Similar parameter calculations carried out for common P-shell hyperfragments are used to predict the binding energies of rarer P-shell hyperfragments. The agreement between predicted and experimental values is good, but it is difficult to differentiate between the parallel and antiparallel configurations in this way. A test of the validity of the model of hyperfragments is made by using the same model with S- and P-shell nuclei. The failure of the model in the case of the deuteron is ascribed to the open structure of the deuteron, and it is concluded that the model is adequate for compact or sufficiently bound nuclei. The corrections for loose binding, e.g., of $_\Lambda H^3$, are discussed. The main results from this model are spin dependence of Λ-nucleon interaction, zero spin of $_\Lambda He^4$, odd parity of kaons, weakness of Λ-nucleon interaction, and slowly varying extended wave function of the Λ⁻ hyperon. (D.L.C.)

2123

THE DIRAC EQUATION FOR MANY-ELECTRON SYSTEMS. K. S. Viswanathan (Raman Research Inst., Bangalore, India). Proc. Indian Acad. Sci., Sec. A 52, 35-45(1960) July. (In English)

It is shown that the Dirac equation for an electron moving in a field can be derived by expressing the magnitude of the momentum four-vector in terms of its components. By considering a four-vector whose components denote the total momentum and energy of the particles, a relativistic equation for a system of several electrons is derived. A representation of this equation is made in the product space of the electrons and, for the special case of a system containing two electrons, leads to the well-known Breit equation. (auth)

2124

THE SCATTERING OF 29 MeV ^{3}He-PARTICLES BY ^{1}H, ^{2}H, ^{3}He AND ^{4}He NUCLEI. D. J. Bredin (Univ. of Birmingham, Eng.), J. B. A. England, D. Evans, J. S. C. McKee, P. V. March, E. M. Mosinger, and W. T. Toner. Proc. Roy. Soc. (London) A258, 202-14(1960) Oct. 18.

Angular distributions for the scattering of 29 Mev He^3 particles by light nuclei were observed using a photographic plate method. Absolute differential cross sections for elastic scattering, and for inelastic processes for H^2, He^3, and He^4 nuclei, are given within the center-of-mass angular range of 20 to 150°. The elastic scattering distributions for the H^1 and He^3 nuclei were compared with predictions based on resonating group theory. (auth)

2125

POLARIZATION OF THE RECOIL NUCLEON FROM THE PHOTOPRODUCTION OF PION. Masaaki Kawaguchi (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 984-8 (1960) June. (In English)

The transverse polarization of the recoil proton from $\gamma + p \rightarrow \pi^0 + p$ is estimated for E_γ = 260, 300, 320, 350, and 400 Mev in a phenomenological way. Calculation of the polarization is carried out for unpolarized incident particles, where the contribution from the electric quadrupole radiation in the $p_{\frac{3}{2}}$ state is neglected. Only the experimental angular distributions of $\gamma + p \rightarrow \pi^0 + p$ and $\gamma + p \rightarrow \pi^+ + n$, and six phase shifts of the pion-nucleon scattering are used as known quantities. Six transition amplitudes of the photopion production, corresponding to $s_{\frac{1}{2}}$, $p_{\frac{1}{2}}$, and $p_{\frac{3}{2}}$ final states with isotopic spin 1/2 and 3/2, can be expressed in terms of these known quantities after six simultaneous quadratic equations are solved. Then 10 to 20% polarization is theoretically expected over a wide range of angles in the center of mass system. The obtained transition amplitudes are reviewed. (auth)

2126

PION-NUCLEON INTERACTION, ANOMALOUS MAGNETIC MOMENT OF NUCLEON AND COMPOSITE MODEL FOR PION. Chiaki Ihara (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1035-54(1960) June. (In English)

The effective pion-nucleon interaction and the anomalous magnetic moment of the nucleon are calculated on the basis of the composite model for the pion in which the fundamental interaction is assumed to be an adequate linear combi-

nation of scalar, tensor, and pseudoscalar, or vector and pseudovector Fermi type couplings. The results are qualitatively in agreement with experiment. (auth)

2127

A POSSIBLE SYMMETRY IN SAKATA'S MODEL FOR BOSONS–BARYONS SYSTEM. [PART] II. Mineo Ikeda (Hiroshima Univ.), Shuzo Ogawa, and Yoshio Ohnuki. Progr. Theoret. Phys. (Kyoto) 23, 1073-99(1960) June. (In English)

In the previous paper a possible symmetry among the proton, neutron, and Λ-particle in Sakata's model was discussed and some physically interesting results were obtained in bosons-baryons systems. This symmetry is equivalent to the invariance of the theory under transformations of the unitary group U(3) of degree three. A mathematical structure of the work is studied in more detail. (auth)

2128

BOUND STATES IN FOUR-NUCLEON COUPLING. Hiroshi Yamamoto (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1100-16(1960) June. (In English)

An interaction Lagrangian of general four-nucleon coupling is assumed and equations for nucleon-antinucleon and two-nucleon systems in three types of chain approximation are derived from the interaction and solved exactly. Then the mathematical structure of the solutions is studied in various cases, and the regions where the value of the coupling constant must lie in order to give the bound states are obtained in the case of pseudoscalar coupling. Some interesting features are pointed out. (auth)

2129

INTERACTIONS INDUCED BY HIGH ENERGY NEUTRINOS. Yoshio Yamaguchi (European Organization for Nuclear Research, Geneva). Progr. Theoret. Phys. (Kyoto) 23, 1117-37(1960) June. (In English)

High-energy neutrino-electron and neutrino-nucleon collisions are discussed. In particular, the "elastic" processes $\bar{\nu} + p \rightarrow n + e^+$ and $\nu + n \rightarrow p + e^-$ are investigated in detail. The cross section of $\nu + n \rightarrow p + e^-$ is estimated to be $\sim 0.8 \times 10^{-38}$ cm^2 for neutrino energy in lab system >1 bev under the reasonable assumptions. (auth)

2130

INTEGRAL REPRESENTATIONS OF BETHE-SALPETER AMPLITUDES. Masakuni Ida (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1151-6(1960) June. (In English)

An integral representation is shown for the matrix element between the vacuum state and a one-particle state of the T-product of two field operators (two-body Bethe-Salpeter amplitudes). It is a generalization of the representation introduced by Wick. The derivation makes use of the Lorentz invariance, microcausality, asymptotic conditions, spectral conditions plus the stability condition. (auth)

2131

S-WAVE K MESON-NUCLEON INTERACTION. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1163-73(1960) June. (In English)

An approach to s-wave K-N interaction is made along the same line with a previous study for π-N scattering. The characteristic property of K-N interaction in the nucleon core is expressed in terms of the change of the value of coupling constant, and it is suggested that the introduction of indefinite metric may be necessary in some sense to describe the phenomena in nucleon core correctly. Moreover, an attempt to obtain the forward scattering amplitude for K-N scattering is made on the basis of the above consideration of the characteristic property of K-N interaction. It is shown that the results are not inconsistent with the experimental ones. Finally some discussion about the coupling constant is made in comparison with the results obtained by many authors. (auth)

2132

A UNIFIED MODEL FOR ELEMENTARY PARTICLES. Ziro Maki, Masami Nakagawa, Yoshio Ohnuki, and Shoichi Sakata (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto) 23, 1174-80(1960) June. (In English)

By extending the Sakata model, a unified model for elementary particles is proposed; the basic particles in the Sakata model are assumed to be constructed of the lepton and B^+, which is regarded as a new kind of matter. The full symmetry among three basic particles and the symmetrical property of the weak interactions which was recently pointed out by Gamba, Marshak, and Okubo come automatically of this model. The nature of B^+ and the new mechanics which account for the binding of B^+ to the lepton will be the central problem to be studied in the future. (auth)

2133

ON THE STRUCTURE OF THE ELEMENTARY PARTICLES. Ken-iti Matumoto and Masami Nakagawa (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto) 23, 1181-8 (1960) June. (In English)

Recently a unified model for the elementary particles (called "the Nagoya Model") was proposed in which the basic baryons in the Sakata model are assumed to be composed of the leptons and a new kind of matter, B. Through the investigation of the mass formula for the compound particles in the Sakata model, it is shown that the B-matter has a charge-like character similar to the electric charge ($e = -\bar{e}$). On the basis of this character of the B-matter, (i) the mass formula (the bond character and the mass-bond relation) is reproduced, (ii) physical ground is given to Taketani's idea, and his idea is developed. A dynamical law of the basic baryons within the compound particle is discussed. Remarks on new boson-baryon family and photon are given. (auth)

2134

ELECTROMAGNETIC STRUCTURE OF THE NUCLEON. IV. CHARGE DISTRIBUTION OF THE PROTON. Kichiro Hiida, Noboru Nakanishi, and Takanori Shiozaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1189-1203(1960) June. (In English)

It is suggested from experimental data and theoretical analyses that the charge distribution function of the proton will become negative in the inner region. The analysis of Stanford data on the electron-proton scattering is reexamined, and a lower bound for $(r^2)_{1,p}$ is given model-independently from some general assumptions. As examples, two trial proton models are considered which are consistent with the present Stanford data and in which the values of $(r^2)_{1,p}$ are rather smaller than the usually accepted ones. (auth)

2135

FORM FACTOR AND STRUCTURE OF PARTICLES. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1204-5(1960) June. (In English)

In relativistic field theory, the particle and probability densities differ except where the effects of particle-antiparticle pairs may be neglected, in which case the probability density acquires physical meaning. The model in which M dissociates into m and m′ is considered. In the peripheral region, the m-particle density $F_m(x)$ may either have a large or a negligible pair effect contribution. The former case is taken to define M as an elementary particle, while the latter case defines M as a composite particle

This definition of the elementary particle is shown to be identical with Oehme's definition. (D.L.C.)

2136

ANOMALOUS CREATION OF μ-MESONS ORIGINATING IN WEAK INTERACTIONS. Hideaki Nagai and Diasuke Itô (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 1207-9(1960) June. (In English)

Since anomalous creation of mesons(μ) has been observed experimentally in super high-energy collisions above 10^{15} ev, a simple estimation is carried out on meson(μ) production caused by weak interactions in the super high-energy region, using a proton collision with a fixed field as an example. The cross sections for meson(μ) and meson(π) production from the collision are calculated to be comparable to each other when the transferred energy reaches $\sim 8 \times 10^{12}$ ev. If this is for the center-of-mass system, the corresponding value for the laboratory system is $\sim 10^{16}$ ev, which is where the anomalous meson(μ) creation was observed. It is pointed out that, if this mechanism is correct, the produced particles should be extremely collimated. (D.L.C.)

2137

PHENOMENOLOGICAL MODEL OF ELEMENTARY PARTICLE INTERACTIONS. Daisuke Itô, Kenzo Iwata, Shinya Furui, Kanji Fujii, and Tetsuro Sakuma (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto) 23, 1210-11(1960) June. (In English)

A simple, symmetric interaction Lagrangian is shown to apply to almost all the interactions of elementary particles, including both weak and strong. (D.L.C.)

2138

THE EFFECT OF π^2 TERM IN THE S-WAVE π-N SCATTERING. Isao Umemura (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto) 23, 1216-18(1960) June. (In English)

The effect of the π^2 term on the S-wave π-N scattering phase shifts is evaluated using Lomon and Kobayashi-Klein's approximation methods. If $g^2/4\pi \simeq 15$ and the cutoff momentum $\simeq$ MC, the π^2 term improves agreement between theory and experiment. (D.L.C.)

2139

ENERGIEVERTEILUNG THERMISCH AUSGELÖSTER ELEKTRONEN IN ELEKTRONENSTRAHL. (Energy Distribution of Thermally Ejected Electrons in an Electron Beam). Wolfgang Kunze. Thesis, Berlin, Technische Universität, 1959. 43p.

The energy distribution of thermally produced electrons in an electron beam was studied with an opposing field arrangement. An increase of path width caused, at sufficient beam current densities, a further broadening of the energy distribution. Changing the anode potential from 0.8 to 36 produced, at otherwise constant parameters, no changes in energy distribution broadening. Other results are described and discussed. (T.R.H.)

Nuclear Properties and Reactions

2140 CF-59-8-85

Oak Ridge National Lab., Tenn.

METHODS FOR APPLYING TRANSMISSION AND η-vs-E CORRECTIONS IN THE DETERMINATION OF η_{2200} BY THE MACKLIN-deSAUSSURE EXPERIMENT. Edith C. Halbert, Betty F. Maskewitz, and R. L. Wynn. Aug. 17, 1959. 45p. OTS.

A careful determination of η_{2200} from results of the Macklin-deSaussure manganese-bath experiment involves corrections for (1) the weak but nonzero transmission of subcadmium neutrons through the uranium or plutonium foils and (2) the small variation of η with energy in the subcadmium region. The derivation of a single general expression for applying both these corrections is presented, and two IBM 704 codes (MTC and GTC) which were written especially to facilitate the numerical evaluation of this combined correction factor are described. (auth)

2141 CRT-927

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

THEORETICAL EVALUATION OF SELF-SHIELDING FACTORS DUE TO SCATTERING RESONANCES IN FOILS. W. N. Selander. June 1960. 63p. (AECL-1077). AECL.

A semi-analytical method is given for evaluating self-shielding factors for activation measurements which use thin foils having neutron scattering resonances. The energy loss by scattering in the foil is taken into account. The energy-dependent neutron angular distribution is expanded as a double series, the coefficients of which are (energy dependent) solutions of an infinite set of coupled integral equations. These are truncated in some suitable manner and solved numerically. The leading term of the series is proportional to the average, or effective flux in the activation sample. The product of this term and the neutron capture cross-section is integrated numerically over the resonance to give the resonance self-shielding correction. Resonance self-shielding factors derived in this manner for the 132 ev resonance in Co^{59} and for the two Mn^{55} resonances at 337 and 1080 ev are shown. Self-shielding factors for 1/v capture are not significantly different from unity. (auth)

2142 NP-9136

United States Rubber Co., Wayne, N. J.

NUCLEAR CHEMISTRY OF SHORT-LIVED ISOTOPES. Technical Status Report No. 2 for May 1, 1960 to July 31, 1960. R. H. Ewart and A. W. Stoner. Aug. 8. 1960. 6p. Contract AF49(638)-815.

A scintillation study of the radiations of Dy^{166} resulted in an internally consistent decay scheme. Radiations observed were 84, 291, 343, 373, and 427 kev. Work on this decay scheme was discontinued until an instrument is obtained to investigate the conversion electron line spectrum. Small quantities of Er^{172} were prepared. Gamma transitions assignable to Er^{172} are 50, 60, 410, and 610 kev. Additional γ rays were seen, but they are not yet positively assigned to the decay of Er^{172}. A detailed recheck of the calibration of the 3" × 3" NaI well crystal was carried out. (auth)

2143 NP-9139

Norway. Sjökrigsskolen, Bergen.

A NEW NUCLEAR THEORY. H. B. Klepp. [1959?]. 77p.

A simple geometric configuration for atomic nuclei is suggested, and it is shown that isotopic abundance, magic numbers, decay schemes, and fission can be described by the system. A potential is given which unifies electrostatic and nuclear phenomena. It is shown that the neutron, deuteron, alpha particle, and the basic tetrahedral group can be associated with this potential. The configuration leads to a classification of atomic weights to a high degree of accuracy, the relative accuracy being about 2×10^{-4} amu per nucleon. (W.D.M.)

2144 NP-9166(p.28-33)

Tata Inst. of Fundamental Research, Bombay.

THE DIRECTIONAL CORRELATION OF GAMMA RAYS IN Gd^{152}. S. K. Bhattacharjee and S. K. Mitra.

The spin of the 1114-kev level of Gd^{152} was determined by angular-correlation measurements of the 770-344 kev γ

cascade in a europium sample enriched with Eu^{152}. The results are in good agreement with the theoretical cascade correlation function, and a spin I = 3 is assigned to the 1114-kev level which agrees with Ofer's work. (D.L.C.)

2145 NP-9166(p.34-43)
Delhi. Univ.
THE γ/β BRANCHING RATIO IN THE DECAY SCHEME OF K^{40}. N. K. Saha and J. B. Gupta.

An independent determination of the γ/β branching ratio in K^{40} decay was made by improving the geometry of measurement, reducing the number of corrections to a minimum, and directly estimating the bremsstrahlung correction due to K^{40} β rays. Thick samples of pure K_2SO_4 were used with copper and aluminum β counters and a NaI(Tl) γ counter. Comparsion sources of K_2SO_4 or $CaSO_4$ mixed with uranyl nitrate for β rays and with $Co^{60}Cl_2$ solution for γ rays were used. Because of the thickness of the samples and their identical geometry and density, most of the correction factors of earlier work were eliminated. The bremsstrahlung correction was estimated to be ~2%. The results obtained were: Specific β-ray disintegration rate of K^{40} = 28.8 ± 0.9/sec/g of ordinary potassium. Specific γ-emission rate of K^{40} = 3.22 ± 0.15/sec/g of ordinary potassium. γ/β branching ratio = 0.112 ± 0.007. Half life of β decay = $1.40 \pm 0.08 \times 10^9$ years. Half life of electron capture = $1.26 \pm 0.06 \times 10^{10}$ years. Total half life of K^{40} decay = $1.3 \pm 0.15 \times 10^9$ years. The above results are in good agreement with earlier data. The one-to-one coincidences observed between the electron capture soft x ray and the γ-ray quanta supports the assumption that the γ rays follow potassium capture in K^{40}. The implications of the results for geology and atmospheric argon contents are discussed. (D.L.C.)

2146 NP-9166(p.44-8)
Saha Inst. of Nuclear Physics, Calcutta.
DECAY OF Eu^{152} (ENRICHED). P. Mukherjee.

The β spectrum of Eu^{152} was redetermined using reactor-irradiated Eu^{151} 2 months after irradiation and a spectrometer of 1.5% energy resolution. Plots of the K, L, and M conversion lines of the 122-kev γ ray indicate that the K binding energy should be assigned to Sm^{152}; all the relatively intense γ lines reported by Nathan and Waggoner were observed, but the 101-kev line reported by Bhattacharjee et al. was not observed. A Kurie plot revealed three beta branchings. (D.L.C.)

2147 NP-9166(p.54-75)
Saha Inst. of Nuclear Physics, Calcutta.
NUCLEAR MANY BODY PROBLEM. (Review). M. K. Banerjee.

An extensive treatment of the nuclear many-body problem in complex nuclei is given with Hartree-Fock and Brueckner methods as a starting point. The Hartree-Fock method is shown to be inadequate for the many-body problem, while the Brueckner method proposes that the interaction between two particles be considered exactly, i.e., considering Feynman's diagrams of all order connecting the same pair of particles. However, in the Brueckner method, the self-consistent single-particle energy spectrum must be determined, and its neglect of three or more particle cluster terms is not valid for high densities. The interaction of two nucleons inside nuclear matter is calculated; the Brueckner method ignores three-particle interactions. The case of a finite nucleus with varying density is considered. The advantage of the Brueckner method is that it shows the limitations of the shell model and how it works. (D.L.C.)

2148 NP-9166(p.76-80)
Saha Inst. of Nuclear Physics, Calcutta.
BRUECKNER THEORY OF NUCLEAR MATTER. Suprokash Mukherjee.

The energy per particle in nuclear matter was calculated, using the Brueckner theory and the effective mass approximation, and the results were plotted, giving a minimum at $r_0 = 0.86 \times 10^{-13}$ cm. It is found that it is impossible to achieve saturation at $r_0 = 1.18 \times 10^{-13}$ cm with Gammel-Thaler potentials, which explains two-body scattering and polarization very well. It is stated that, since 2 to 3% inaccuracy of the wave function can bring in an error as large as 20% in the binding energy, neglect of an attraction term on the ground of a small effect on the wave function is unjustified. (D.L.C.)

2149 NP-9166(p.81-3)
Aligarh Muslim Univ., Aligarh, India.
TWO-BODY NUCLEAR PARAMETERS FOR BRUECKNER THEORY. A. N. Mitra.

The role of two-body spin-orbit forces in low-energy nuclear phenomena, in addition to the tensor force, was investigated using a Yamaguchi potential with an additional term to represent the effect of a spin-orbit force on the d-state of a two-body system. The potential was solved for the magnetic moment, binding energy, d-state probability, quadrupole moment, and other parameters of the deuteron and for the spin-orbit splitting in Ca^{41} and O^{17}. In the latter case, the results compared with the observed and Signell-Marshak's values show that the tensor force alone is inadequate and that the spin-orbit term brings about good agreement with observation, better than the Signell-Marshak potential. (D.L.C.)

2150 NP-9166(p.90-4)
Physical Research Lab., Ahmedabad, India.
SOME APPLICATIONS OF GEOMETRICAL THEOREMS IN jj COUPLING NUCLEAR SHELL MODEL. Sudhir P. Pandya.

The method of using geometrical relations in the matrix elements of related configurations in the coupling nuclear shell model to predict level schemes of nuclei is used to predict some of the energy levels of Cr^{53}, Fe^{55}, Co^{56}, Co^{57}, and Co^{58}. The level schemes of Cr^{53} and Fe^{55} are expected to be very similar, at least for low states, and the Co^{57} and Co^{58} levels are calculated in terms of those of Co^{56}. The predictions are compared with those made by Lawson and Uretsky's center of gravity theorem in nuclear spectroscopy; it is concluded that new experimental data on these nuclei would be valuable for testing the predictions. (D.L.C.)

2151 NP-9166(p.95-7)
Saha Inst. of Nuclear Physics, Calcutta.
A SHELL MODEL CALCULATION WITH MODIFIED SINGLE-PARTICLE WAVE-FUNCTIONS. Binayak Dutta-Roy.

Shell-model calculations with modified single-particle wave functions are made for nuclei in which the 1 $f_{\frac{7}{2}}$ shell is being filled and in which the two-particle system has one particle in the m state and the other in the −m state. The internucleon potential used is a Gammel-Thaler potential, and its matrix elements are calculated in the Brueckner way with the reaction matrix. The levels corresponding to total angular momentum J = 0, 2, 4, and 6 are projected out of the $(\frac{1}{2}, -\frac{1}{2})$ band, and the level spacings agree quite well with the experimental values. (D.L.C.)

2152 NP-9166(p.98-101)
Saha Inst. of Nuclear Physics, Calcutta.
STABILITY OF NUCLEAR OCTUPOLE DEFORMATION. Paresh Mukherjee and Ila Dutt.

A formalism is devised in which the effect of spin-orbit interaction on the energies of nucleons moving in a pear-shaped potential can be calculated, and an equation is derived for the extra energy due to the pear-shaped deformation of the nucleus. A plot is given of the energy of a single nucleon moving in a pear-shaped potential; it is evident that single-particle energy levels are markedly affected. The energy difference between a pear-shaped and a spheroidal nucleus is calculated for Ra^{226} to be $+83.774\ a_3^2\ \hbar\omega_0$; the energy is positive for any value of a_3, and therefore the pear-shaped nucleus is not energetically stable for Ra^{226}. (D.L.C.)

2153 NP-9166(p.120-2)
Tata Inst. of Fundamental Research, Bombay.
STUDY OF 30 YEAR Ho^{166}. S. Jha, H. G. Devare, M. Narayana Rao, and G. C. Pramila.

The 30-year isomer of Ho^{166} was studied with conventional coincidence methods, and the decay scheme of Milton et al. and Grace et al. was confirmed as far as the γ emissions are concerned. The 180-kev peak was found to be complex, consisting of a 180-kev γ ray and a 200-kev γ ray, the latter being in coincidence with a 600-kev γ ray. The β spectrum of the isomer was also studied in a scintillator spectrometer and found to consist of at least two groups, one with an end point at ~400 kev and the other at ~1200 kev. The β spectrum coincident with the 820- and 720-kev γ rays had its end point at 400 and beyond 800 kev, respectively. The γ spectrum in coincidence with β rays of energy >600 kev showed the 720-kev peak but not the 820-kev peak; it is concluded that, in the 820-720-185-80-kev γ cascade, the 820-kev γ ray arises from a transition from the 1800-kev level to the 982-kev level. A tentative decay scheme is presented. (D.L.C.)

2154 NP-9166(p.123-51)
Saha Inst. of Nuclear Physics, Calcutta.
HEAVY ION RESEARCHES. (Review). D. N. Kundu.

An extensive review of research on heavy-ion bombardment is given with the following topics: (1) heavy-ion acceleration; (2) transmutation studies (transuranic elements, neutron-deficient isotopes, and other transmutation studies); (3) reaction studies (evaporation, stripping, special reaction mechanisms, fission, scattering, and radiative capture); (4) Coulomb excitation; (5) heavy-ion physics; and (6) miscellaneous studies. 110 references. (D.L.C.)

2155 NP-9166(p.152-70)
India. Atomic Energy Establishment, Trombay.
NUCLEAR FISSION. (Review). R. Ramanna.

A review is presented on fission processes. It covers a wide variety of topics including mass asymmetry of fission fragments, fission cross sections, angular distributions of fission fragments, liquid drop model, collective model, new nuclear models, and neutron-emission spectra. 39 references. (D.L.C.)

2156 NP-9166(p.171-4)
Saha Inst. of Nuclear Physics, Calcutta.
INTERPRETATION OF LOW ENERGY INELASTIC SCATTERING. D. Mitra.

Inelastic scattering of nucleons by nuclei can proceed via three types of processes. Besides the first process in which the projectile is directly scattered, the second process involves the projectile knocking one of the exchangeable nucleons out of the nucleus, and the third process resembles the second except that the interaction binding the projectile is with the nucleus and not with the nucleon knocked out. By calculations on the momentum transfers suffered by the nucleons in all three processes, it is found that when the energy increases, the probability of the third process decreases much more rapidly than that of the first two, roughly as $\exp(-K^2R^2)$ up to 16 Mev, where K = momentum and R = nuclear radius. Below 16 Mev, the third process contribution is ~70% of those of the first two. The inelastic scattering of 10.8-Mev protons from C^{12} leading to its first excited state (4.43-Mev 2^+ level) was calculated taking the third process into account and compared with experiment; a good fit is obtained. (D.L.C.)

2157 NP-9166(p.207-16)
Lucknow, India. Univ.
AN INVESTIGATION OF THE $Li^7(d,n)Be^8$ NUCLEAR REACTION USING THE PHOTOGRAPHIC EMULSION TECHNIQUE. J. P. Sah.

The neutron spectrum from $Li^7(d,n)Be^8$ was reinvestigated by bombarding an 86-kev thick Li^7 target with 635-kev deuterons and detecting the emitted particles in 400-μ thick Ilford G5 nuclear emulsion plates. Only those tracks originating 50 to 250 μ below the emulsion surface and fulfilling angle and length conditions were counted. At four angles of observation (0, 45, 90, and 135°), a total of 817 recoil proton tracks was recorded. The neutron-energy spectrum at 135° indicates the 2.9-Mev level clearly, but there is only a slight indication of the 5.3- and 7.5-Mev levels found in other investigations, and they cannot be significant in view of the possible statistical fluctuations. Broad 5- and 10-Mev levels are also present. The contributions of three-particle interactions appear to be very small. The neutron angular distribution was also obtained together with lower neutron-energy spectra for which the contributions of various reactions were calculated. (D.L.C.)

2158 NP-9193
Institut za Nuklearne Nauke "Boris Kidric," Belgrade.
LECTURES GIVEN AT IV. SUMMER MEETING OF NUCLEAR PHYSICISTS, SEPTEMBER 1959, HERCEGNOVI, YUGOSLAVIA. R. V. Popić, ed. 311p.

Nine lectures on nuclear reactions at medium energies given at the 1959 summer meeting of nuclear physicists are presented. Topics covered include general theory of nuclear reactions, the optical model, the many-body problem, interactions of light nuclei, elastic scattering of polarized protons, spectra in inelastic scattering, polarized proton beams and targets, neutron-induced medium-energy reactions, and direct capture and photonuclear reactions. Separate abstracts were prepared for each lecture. (W.D.M.)

2159 NP-9193(p.1-25)
Manchester, England. Univ.
GENERAL THEORY OF NUCLEAR REACTIONS. B. H. Flowers.

Topics considered and a general theory of nuclear reactions include scattering by potential, the interior region, a simple example, effective range theory, quasistationary states, configuration space and channels, the R-matrix, effect of far-off levels, average total cross sections, individual levels in light nuclei, random phases, and behavior of near thresholds. (W.D.M.)

2160 NP-9193(p.26-100)
Nordisk Institut for Teoretsk Atomfysik, Copenhagen.
FOUNDATIONS OF THE OPTICAL MODEL AND DIRECT INTERACTIONS. L. Rosenfeld.

The foundations of the optical model are discussed, and it is shown how the treatment of direct interactions follows from this general scheme. Topics discussed include the resonant states of a fixed potential, the reaction matrix, resonances and dispersion formula, the optical model, partial widths and strength function, parameters of the optical model, and direct interactions. (W.D.M.)

2161 NP-9193(p.101-49)
France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay.
THE MANY-BODY THEORY. C. Bloch.

One of the simplest problems in many-body theory is considered: that of the calculation of the binding energy of a system. The problem treated is that of finding the ground state of a system of nucleons which are enclosed in a box which is assumed to be cube-shaped. An infinite system is also assumed. (W.D.M.)

2162 NP-9193(p.150-82)
Los Alamos Scientific Lab., N. Mex.
INTERACTION BETWEEN LIGHT NUCLEI. Louis Rosen.

A survey of scattering and reaction experiments at medium energies is presented. All the possible interactions between n, p, d, t, He^3, and He^4 are treated. (W.D.M.)

2163 NP-9193(p.184-202)
Los Alamos Scientific Lab., N. Mex.
ELASTIC SCATTERING OF COMPLETELY POLARIZED 10 MeV PROTONS BY COMPLEX NUCLEI. Louis Rosen.

Experiments are described in which an attempt was made to isolate and study directly the spin-orbit force in nuclear reactions for a large variety of nuclei, with the eventual objective of discovering the potential that gives a quantitative description of the elastic scattering and polarization in all cases. The elastic scattering of 10-Mev polarized protons on D, He, C, N, O, F, Ne, Mg, Al, Ar, Ti, Fe, Ni, Cu, Kr, Ag, Xe, and Au was investigated. (W.D.M.)

2164 NP-9193(p.203-39)
France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay.
SPECTRA IN INELASTIC SCATTERING—EVIDENCE FOR COLLECTIVE EXCITATION. J. Thirrion.

The evidence of direct interaction can be mostly characterized by the following properties: (1) forward angular distribution; (2) shape of spectra of the emitted particles different from that predicted by evaporation theory; and (3) cross sections higher than those given by evaporation theory. Inelastic-scattering reactions leading to low excitations of the final nucleus are considered. (W.D.M.)

2165 NP-9193(p.240-7)
France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay.
THE PREPARATION OF POLARIZED PROTON BEAMS AND TARGETS. J. Thirrion.

The principle of obtaining polarized protons is reviewed. Various accelerator projects for preparing polarized beams and targets are discussed. (W.D.M.)

2166 NP-9193(p.248-68)
Centro Informazioni Studi Esperienze, Milan.
SURVEY OF EXPERIMENTAL RESULTS ON MEDIUM ENERGY NUCLEAR REACTIONS INDUCED BY NEUTRONS AND EXPERIMENTAL TECHNIQUES. U. Facchini.

A general review is given and experimental results are discussed for the (n,n'), (n,2n), (n,p), (n,np), (n,d), and (n,α) reactions. (W.D.M.)

2167 NP-9193(p.269-304)
Heidelberg, Germany. Universitat.
DIRECT CAPTURE AND PHOTONUCLEAR REACTIONS. F. Beck.

The occurrence of radioactive phenomena during nuclear reactions is considered in terms of the direct or simple particle model. A general survey is given, and the interaction of nuclei with electromagnetic radiation, capture cross sections in the statistical model, and direct-capture reactions at low and medium energies are discussed. (W.D.M.)

2168 NP-9215
Paris. Université, Orsay. École Normale Supérieure, Faculté des Sciences.
A MODEL FOR THE CALCULATION OF THE OPTICAL POTENTIAL IN SOME FINITE NUCLEI. Technical Note No. 20. B. Jancovici. 1960. [26p]. Contract AF61(052)-173.

The imaginary part of the optical potential is computed in second order in a harmonic oscillator shell model for He^4, O^{16}, and Ca^{40}. Finite nucleus shell model wave functions are consistently used. The results show a good agreement with those of the Thomas-Fermi approximation, providing a check for the validity of the latter. A stronger absorption on the surface is predicted; this effect is therefore not a spurious effect of the Thomas-Fermi approximation. (auth)

2169 NYO-7687
Carnegie Inst. of Tech., Pittsburgh.
NATURAL ALPHA RADIOACTIVITY IN MEDIUM-HEAVY ELEMENTS (thesis). Ronald D. Macfarlane. May 28, 1959. 174p. Contract AT(30-1)-844. OTS.

A large internal-sample ionization chamber was constructed and used in conjunction with a 24-channel pulse analyzer for the purpose of studying weak natural α radioactivities among the medium-heavy elements. A method was developed for forming thin, uniform oxide films over a large cylindrical surface area suitable for obtaining reasonably sharp α spectra. Natural α activities were found in Gd^{152}, Hf^{174}, Nd^{144}, Sm^{147}, and Pt^{190}. Negative results were obtained for Ce^{142}, W^{180}, Sm^{146}, Sm^{148}, Sm^{149}, and Hg^{196}. (W.D.M.)

2170 TID-6511
Rensselaer Polytechnic Inst., Troy, N. Y.
ANNUAL REPORT OF PROJECT ON ANISOTROPIC DIFFUSION. H. B. Huntington. Aug. 1960. 6p. Contract AT(30-1)-1044. OTS.

Measurements were made of marker motions in pure gold and copper wires carrying high d-c currents. Investigation of the self-diffusion in Au–Cd alloys was completed. The final results for radiocadmium gave Q = 28.0 ± 0.07 kcal/mole and D_0 = 0.22 ± 0.1 cm^2/sec and for radiogold gave Q = 27.9 ± 0.3 kcal/mole and D_0 = 0.16 ± 0.03 cm^2/sec. The self-diffusion in antimony along the basal plane was investigated. The diffusion studies of both radiosilver and radioindium in zinc were completed. Results are reported. (W.L.H.)

2171 WASH-1029
Neutron Cross Section Advisory Group, AEC.
REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP, ARGONNE NATIONAL LABORATORY, SEPTEMBER 19–21, 1960. John A. Harvey. Oct. 1960. 84p. OTS.

Informal statements of recent developments, changes of emphasis, and preliminary data which are of importance to the cross-section-measurement program of the AEC are contained. Reports are included from ANL, BNL, Columbia, Duke, Hanford Labs, LASL, ORNL, Phillips, and UCRL. (For preceding report see WASH-1028.) (W.D.M.)

2172
KNIGHT SHIFTS IN POTASSIUM, INDIUM AND YTTRIUM METALS. W. H. Jones, Jr., T. P. Graham, and R. G. Barnes (Ames Lab., Ames, Iowa). Acta Met. 8, 663-4 (1960) Sept.

The Knight shifts were measured with a Varian Model V-4200B wide-line nuclear magnetic resonance spectrometer. The intervals between the centers of the nuclear resonance in the metal and in the diamagnetic reference

sample were measured using the dispersion mode of the NMR signal. In the dispersion mode, the location of the resonance center is insensitive to the position of the noise baseline of the recorded trace. A summary of the relevant Knight shift data for K^{39}, In^{115}, and Y^{89} is tabulated. (B.O.G.)

2173

VIRTUAL BINDING AND ITS RELATION TO RESONANCE SCATTERING. George L. Trigg (Oregon State Coll., Corvallis). Am. J. Phys. 28, 711-15(1960) Nov.

A discussion of virtual binding and resonance scattering is presented in such a fashion as to make clear the relationship between them. (auth)

2174

LEVELS OF N^{15} NEAR 7-MEV EXCITATION FROM $N^{14}(d,p')N^{15}$. John L. Honsaker (California Inst. of Tech., Pasadena). Astrophys. J. 132, 516-17(1960) Sept.

Conflicting results from γ-ray measurements caused Hebbard and Povh to suggest the possibility of an undiscovered energy level in N^{15} near 7-Mev excitation. Targets were prepared by heating 0.010-in. tantalum sheet in commercial ammonia, thus forming tantalum nitride. The target was bombarded with a 700-kev deuteron beam. Protons were analyzed with a 10.5-in. double-focusing magnetic spectrometer at angles of 135 and 160° to the beam. Three groups of protons were found to correspond to the known excited states of N^{15} at 7.16, 7.31, and 7.57 Mev. A smaller group found at 1.47-Mev proton energy was shown to be due to oxygen contamination by comparison with results from an oxidized tantalum target in the same experimental arrangement. The observed width of the groups correspond to ~20-kev in Q-value. Thus it may be concluded that no new level exists in N^{15}, giving a group intensity comparable to those observed, unless such a level is within 10 kev of one of the known levels. (B.O.G.)

2175

THERMAL NEUTRON FISSION CROSS-SECTION OF ^{229}Th. J. E. Gindler, K. F. Flynn, and J. Gray, Jr. (Argonne National Lab., Ill.). J. Inorg. & Nuclear Chem. 15, 1-3(1960) Sept. (In English)

The fission cross section of Th^{229} for thermal neutrons was determined by counting samples placed in the thermal column of the Argonne heterogeneous heavy-water reactor CP-5. Comparison of the fission counting rates of Th^{229} samples with those of U^{233} and Pu^{239} standards gave a cross section value of 30.5 ± 3 barns. (auth)

2176

SHORT-LIVED ISOTOPES OF Nb AND Zr FROM FISSION. C. J. Orth and R. K. Smith (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem. 15, 4-17 (1960) Sept. (In English)

The nuclides Nb^{98}, Nb^{99}, and Zr^{98}, plus three other short-lived β-emitters tentatively identified as Nb^{100}, Nb^{101}, and Zr^{99}, were observed in the Nb and Zr fractions separated from U^{235} fission products. The properties observed are as follows. Nb^{98}: $t_{1/2}$ = 51.5 ± 1.0 min; E_γ(Mev) = 0.330 ± 0.005, 0.720 ± 0.010, 0.780 ± 0.010, 1.16, 1.44, 1.52, 1.68, 1.88, 1.93, 2.24, and 2.7; $E_{\beta\,max}$ = 3.1 ± 0.2 Mev; Q_β = 4.6 ± 0.2 Mev. Nb^{99}: $t_{1/2}$ = 2.4 ± 0.3 min; E_γ(Mev) = 0.100 ± 0.002, 0.260 ± 0.005. Zr^{98}: $t_{1/2}$ = 35 ± 5 sec. Nb^{100}: $t_{1/2}$ = 3.0 ± 0.3 min; E_γ(Mev) = 0.140 ± 0.005, 0.360 ± 0.010, 0.450 ± 0.010, 0.530 ± 0.010, 0.65, 2.2, 2.3, 2.65, and 2.8. Nb^{101}: $t_{1/2}$ = 1.0 ± 0.2 min. Zr^{98}: $t_{1/2}$ ~ 1 min. A search was made for a low-spin isomer of Nb^{98} by rapid β- and γ-counting of Zr samples which were bombarded with 3.0 to 5.5 Mev protons. No activity attributable to such an isomer was observed. The low-spin isometric state, if it exists, has a half-life less than 5 sec. (auth)

2177

THE HALF-LIFE OF ^{181}Hf. M. Lindner, K. V. Marsh, J. A. Miskel, and R. J. Nagle (Univ. of California, Livermore). J. Inorg. & Nuclear Chem. 15, 194-5(1960) Sept. (In English)

The half life of Hf^{181} has been reported as ~45 days. These determinations were made following the decay of thermal-neutron-irradiated hafnium by gross counting of both β and γ radiation. Since the formation of 70 day Hf^{175} under these conditions is comparable to that of Hf^{181}, an attempt was made to minimize the effect of Hf^{175} by production methods and to discriminate counting techniques. Counting efficiencies for the proportional counter and the scintillation counter were comparable for Hf^{181} and varied ~10% for Hf^{175}, with the scintillation counter giving the higher efficiency. Since the slightly longer half life obtained by scintillation counting is consistent with ~3% Hf^{175} and since the proportional counter is insensitive to this contaminant, it is felt that the correct half life for Hf^{181} is 42.45 ± 0.08 days. (B.O.G.)

2178

PREPARATION OF LONG-LIVED HOLMIUM-163. Robert A. Naumann (Univ. of California, Berkeley), Maynard C. Michel, and John L. Power. J. Inorg. & Nuclear Chem. 15, 195-6(1960) Sept. (In English)

A sample of Ho^{163} was prepared by pile neutron irradiation of erbium oxide electromagnetically enriched one-hundredfold in the mass-162 isotope. The sample was exposed to 2 × 10^{21} n/cm² in the MTR. Mass analysis (prior to chemical separation) of the irradiated sample showed the presence of mass-163 and 165 isotopes, which were not observed prior to irradiation. On the basis of the mass analysis, ~5 to 10% of each of the $Er^{162,164}$ isotopes had undergone neutron capture. The sample was chemically fractionated by cation-exchange chromatography to yield pure fractions of the various rare earths. The holmium fraction revealed mass-163 and 165 isotopes, but these isotopes were not observed in comparable yield in the erbium or dysprosium fractions. From the data obtained and on the strength of the K radiation in the holmium fraction, it is concluded that the K-capture half life of Ho^{163} is greater than 1000 years. (B.O.G.)

2179

HYPERFINE STRUCTURE OF Hg^{197}. AN APPLICATION OF THE LEVEL-CROSSING TECHNIQUE. H. R. Hirsch and C. V. Stager (Massachusetts Inst. of Tech., Cambridge). J. Opt. Soc. Am. 50, 1052-3(1960) Nov.

Measurements in the $6\,^3P_1$ state of Hg^{197} yielded a hyperfine structure splitting of 23 083.4 ± 6.7 Mc. Such accuracy was possible in a strictly optical experiment because the change in intensity of scattered light observed at a Zeeman-level crossing is unaffected by Doppler broadening. (auth)

2180

ENERGY DEPENDENCE OF ANGULAR DISTRIBUTIONS OF THE REACTION $Al^{27}(p,\alpha)Mg^{24}$ IN THE ENERGY REGION BETWEEN 10.5 AND 14.5 MEV. Hiroshi Ogata and Hidehiko Itoh, Yoshiko Masuda, Kunio Takamatsu, Maumi Kawashima, Akira Masaike, and Isao Kumabe (Kyoto Univ.). J. Phys. Soc. Japan 15, 1719-25(1960) Oct. (In English)

The angular distributions of the reactions $Al^{27}(p,\alpha)Mg^{24}$ resulting in the ground and first excited states of Mg^{24} were measured at 37 energies between 10.5 and 14.5 Mev, making use of proportional counters. Similar behavior was obtained for both reactions. The variation of the shape of the angular distributions with the bombarding energy is rather smooth in the higher energy region, but becomes rapid with decreasing bombarding energy. There appear

some resonance-like peaks and valleys in the excitation curves at laboratory angles of 50, 90, and 130° but their positions are not coincident with one another and in the higher energy region these peaks disappear in the excitation curves for the total cross sections. The variations of the excitation curves for the total cross sections and of the shape of the angular distributions with energy in the lower energy region may be due to the fluctuations in the number or properties of the compound nucleus levels and to the interference between the compound nucleus and direct interaction processes. The smoothing-outs of the excitation curves for the total cross sections and of the variation of the shape of the angular distributions in the higher energy region seem to be due to the effects of decreasing level spacing in the compound nucleus and of increasing contribution from the direct interaction process. However, in the entire energy region, the interference between the compound nucleus and direct interaction processes and some contribution from the heavy particle stripping process cannot be neglected. (auth)

2181

ANGULAR DISTRIBUTIONS OF THE REACTIONS $Co^{59}(p,\alpha)Fe^{56}$ AT 7.7 ~ 14.1 MEV AND $Mn^{55}(p,\alpha)Cr^{52}$ AT 7.6 ~ 12.9 MEV. Hiroshi Ogata, Hidehiko Itoh, Yoshiko Masuda, Kunio Takamatsu, Maumi Kawashima, Akira Masaike, and Isao Kumabe (Kyoto Univ.). J. Phys. Soc. Japan 15, 1726-31(1960) Oct. (In English)

The angular distributions of the reactions $Co^{59}(p,\alpha)Fe^{56}$ and $Mn^{55}(p,\alpha)Cr^{52}$ resulting in the ground and first excited states of the residual nuclei were measured at 7.7, 8.7, 9.8, 10.85, 11.9, 13.1, and 14.1 Mev and at 7.65, 8.85, 9.65, 10.7, 11.8, and 12.9 Mev of the incident proton energy, respectively, making use of proportional counters. Similar behavior was obtained for these four reactions. For the reaction $Co^{59}(p,\alpha)Fe^{56}$ the forward peak in the angular distribution is prominent at 14.1 and 13.1 Mev and disappears gradually with decreasing proton energy, and the angular distribution is ~90° symmetrical below about 11 Mev. For the reaction $Mn^{55}(p,\alpha)Cr^{52}$ the angular distribution is considerably forward peaked at 12.9 and 11.8 Mev and is ~90° symmetrical below about 10 Mev. It was found that the total cross section integrated from the angular distributions for both reactions decrease smoothly with increasing proton energy. It is considered that the reactions $Co^{59}(p,\alpha)Fe^{56}$ and $Mn^{55}(p,\alpha)Cr^{52}$ resulting in the ground and first excited states of the residual nuclei occur through the similar reaction process, that is, in the lower energy region the compound nucleus process plays a predominant role, although some contribution from the direct interaction process cannot be neglected, and the contribution from the direct interaction process becomes gradually significant with increasing proton energy and is predominant above about 11 Mev. (auth)

2182

MIXING RATIO OF THE 440-keV GAMMA RADIATION IN ^{23}Na. Akira Mizobuchi, Toshio Katoh, and Jian-zhi Ruan (Osaka Univ.). J. Phys. Soc. Japan 15, 1737-40(1960) Oct. (In English)

The angular distribution and the direction-polarization of the 440-kev γ rays in $Na^{23}(p,p'\gamma)Na^{23}$ reaction were measured at the 1.29-Mev resonance. For these measurements the following results were observed: for the angular distribution, $W(\theta) = 1-(0.091 \pm 0.004)P_2(\cos\theta)$ and for the polarization parameter, $p = +0.69 \pm 0.02$. From the observed results, the mixing ratio of the 440-kev γ radiation was obtained as $(E2/M1)^{\frac{1}{2}} = +0.045 \pm 0.015$. This value agrees with the prediction from the collective model. (auth)

2183

(d,α) REACTIONS ON SOME LIGHT NUCLEI. Chuin Hu (Osaka Univ.). J. Phys. Soc. Japan 15, 1741-52(1960) Oct. (In English)

Angular distributions of the emergent α particles from the reactions $O^{16}(d,\alpha_0)N^{14}$(ground), $N^{14}(d,\alpha_0)C^{12}$(ground). $N^{14}(d,\alpha_1)C^{12*}$(4.44-Mev state), $F^{19}(d,\alpha_0)O^{17}$(ground), $F^{19}(d,\alpha_1)O^{17*}$(0.872-Mev state), and $P^{31}(d,\alpha_0)Si^{29}$(ground) were investigated at several bombarding energies in the region from 10.3 to 11.4 Mev. The distributions which cover the angular range between ~25 and 160° in the center-of-mass system exhibit generally oscillatory and forward peaking behavior. The intensity of the transition to the 2.31 Mev (T = 1) state of N^{14} was measured in the range from 10.5 to 11.4 Mev in the step of 100 kev interval by aluminum absorber. The α particles from the targets were detected by a thin CsI(Tl) crystal scintillation spectrometer. The experimental results were compared with the theoretical curves calculated by simplified direct-interaction model of Butler and the model which includes the heavy-particle-stripping process. Attempts to fit some data were also made by using an approximate expression derived by Newns for double-stripping process. (auth)

2184

EMISSION OF ^8Li, ^9Li AND ^8B FRAGMENTS FROM STARS PRODUCED BY 4.3 GEV π^--MESONS IN NUCLEAR EMULSION. Kuni Imaeda, Mitsuko Kazuno, and Nobuo Ito (Yamanashi Univ., Kofu, Japan). J. Phys. Soc. Japan 15, 1753-9 (1960) Oct. (In English)

Nine thousand and three hundred stars with more than 5 black prongs were examined to study Li^8, Li^9, and B^8 fragments emitted from these stars. Thus 90 examples of hammer tracks produced by Li^8 and B^8 fragments, 11 examples of tracks produced by $Li^9 \rightarrow Be^9 + e^- \rightarrow He^4 + He^4 + n + e^-$ and one example produced by $Li^9 \rightarrow Be^9 + e^- \rightarrow He^5 + He^4 + e^-$ were obtained. The experimental result of angular distribution, energy distribution, and frequency of emission of these fragments is given. Comparison is made between the experimental result and the prediction of evaporation theory on the frequency of emission of these fragments. The effect of the B^8 fragments on the estimation of the Coulomb barrier of the residual nucleus for Li^8 fragment is discussed. (auth)

2185

ON THE EFFICIENCY OF THE REACTION $H^3(d,n)He^4$ IN TITANIUM TRITIDE BOMBARDED WITH DEUTERONS. E. M. Gunnersen and G. James (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Instr. & Methods 8, 173-84(1960) Aug. (In English)

The lack of accurate energy loss data in metals (and particularly in titanium tritide) of deuterons of less than 100 kev is shown to cause large uncertainties in calculations of the neutron yield produced by the $H^3(d,n)He^4$ reaction when a titanium tritide target is bombarded with low-energy deuterons. Direct measurements of the energy loss in titanium hydride foils of 40 to 150 kev deuterons were made and used in combination with data in the literature for other metals and higher ion energies to recalculate the neutron yield from this $H^3(d,n)He^4$ reaction in titanium tritide for the deuteron energy range 9 to 150 kev. Using this yield curve, a technique is described for estimating how tritium concentration varies with depth in the titanium tritide material by examining the observed variation of neutron yield with incident angle and energy of the bombarding deuteron beam. It was found that the concentration peak is never less than 3000 A below the surface, and that there is very little tritium contained in an upper surface

layer of about 500 A, or in the lower one-third of the titanium tritide material. (auth)

2186

THE DECAY MODES OF THE 9.17-Mev EXCITED STATE IN N^{14}. H. J. Rose (Universität, Freiburg i.B.). Nuclear Phys. 19, 113-39(1960) Oct. (1). (In English)

A search was made for the γ rays and γ-cascade transitions resulting from the decay of the 9.17-Mev excited state in N^{14} using the reaction $C^{13}(p,\gamma)N^{14}$ at the 1.75-Mev resonance. The main purpose of the investigation was to gain information about the "missing" (2,0) and (2,1) levels arising from the p^{-2} configuration in mass 14 by obtaining a detailed decay scheme for the 9.17-Mev state. For that purpose, three-crystal pair spectrometer techniques were applied to search for γ rays too weak to be detected by single spectra measurements in the presence of the strong 9.17 Mev → ground-state transition. In addition to the previously reported transitions from the 9.17-Mev state to the ground state and the 6.44-Mev excited state, a transition was observed to the 7.03-Mev excited state. Furthermore, three-crystal pair spectra measurements and coincidence measurements indicate a transition from the 9.17-Mev excited state to the (presumably) odd-parity T = 0 state at 5.83 Mev and possibly to the 5.69- and 5.10-Mev states. Upper limits were placed on the transitions to the 5.69- and 5.10-Mev states. Observation of γ rays with energies of 1.64 and 2.49 Mev in three-crystal pair spectra measurements and in several coincidence measurements gave evidence that the 6.44-Mev excited state branches to the 3.95-Mev (1,0) state. To obtain anisotropies and intensities relative to the 9.17 Mev → ground-state transition for the γ rays observed, three-crystal pair spectra were taken at 0 to 90° relative to the proton beam. The results of these measurements (combined with results about the 9.17 → 6.44 Mev → ground-state transition published recently) lead to spin assignments of J = 2 to the 9.17-Mev level and of J = 3 to the 6.44-Mev level. Furthermore, they lead to a spin assignment of J = 2 to the 7.03-Mev excited state in N^{14}. The latter assignment and comparison of the strength of the 9.17 → 7.03-Mev transition with results of calculations obtained by Warburton and Pinkston suggest that the 7.03-Mev excited state arises from the p^{-2} configuration as (2,0) level and that the 9.17-Mev level at least in part arises from p^{-2} as (2,1) level. Comparison of the dipole-quadrupole mixture ($0.13 < |\delta| < 3.5$) in the 7.03 Mev → ground-state transition, which was determined from the measured anisotropy of this transition, with theoretical results of Warburton and Pinkston agrees with this conclusion. (auth)

2187

THE NUCLEAR SPINS OF I^{126}, I^{132}, I^{133}, AND I^{135}. Hugh L. Garvin and Edgar Lipworth (Univ. of California, Berkeley). Nuclear Phys. 19, 140-7(1960) Oct. (1). (In English)

Some recent results of a continuing program to determine the nuclear spins, magnetic moments, and electric quadrupole moments of the radioactive halogen isotopes by the method of atomic beams are reported. The determination of the ground-state spins of radioactive isotopes is particularly important for the interpretation of radioactive decay patterns, and the measurements of nuclear spins and moments provide experimental evidence for the formulation and evaluation of nuclear-structure theories. This work completes the measurement of the nuclear spins of the series of iodine isotopes I^{122} to I^{135} with the exception of the 52-min I^{134} isotope. The nuclear spins of I^{126}, I^{132}, I^{133}, and I^{135} are 2, 4, $^7/_2$, and $^7/_2$, respectively. (auth)

2188

MULTIPOLE ORDER OF THE 869 kev GAMMA RAY IN Sm^{152}. Ove Nathan (Univ. of Pennsylvania, Philadelphia). Nuclear Phys. 19, 148-53(1960) Oct. (1). (In English)

The angular correlation of the 869–244-kev gamma-electron cascade in Sm^{152} was measured and the multipole mixture of the 869-kev transition was deduced to be 98.8% E2, 1.2% M1. The influence of the rotation-vibration coupling on the E2 and M1 transitions from the γ-vibrational states in Sm^{152} is discussed. The value of the coupling parameter z was found to be 0.08. (auth)

2189

ENERGY LEVELS OF Si^{29}, Si^{30}, AND Si^{31} FROM (d,p) REACTIONS. C. P. Browne and J. T. Radzyminski (Univ. of Notre Dame, Ind.). Nuclear Phys. 19, 164-72(1960) Oct. (1). (In English)

The $Si^{28}(d,p)Si^{29}$ reaction was used to locate nuclear energy levels in Si^{29} in the range of excitation energy between 3.5 and 9.1 Mev. The bombarding energy was 7.03 Mev and the MIT broadrange spectrograph was used to resolve the particle groups. Identification was based on a change of observation angle and a change of isotopic abundance in the target. A total of 65 levels of Si^{29} was found in the range covered, 54 of which were not previously reported. In addition, 16 particle groups were assigned to the reaction $Si^{29}(d,p)Si^{30}$ and 7 groups to the reaction $Si^{30}(d,p)Si^{31}$. The Si^{30} levels lie in the range of excitation of 6.4 to 10.8 Mev, whereas the Si^{31} levels lie between 2.3 and 5.5 Mev. Q-values and excitation energies are listed for all these groups. The uncertainty in Q-value for most of the levels is ±5 kev. (auth)

2190

SECONDARY REACTIONS IN SPALLATION. Marc Lefort, Gabriel Simonoff, and Xavier Tarrago (Faculté des Sciences de Paris, Orsay, France). Nuclear Phys. 19, 173-83(1960) Oct. (1). (In English)

In the spallation nuclear reactions induced by 150-Mev protons on bismuth and thallium, light fragments were produced. Alpha particles induced secondary reactions. By radio-chemical study of astatine isotopes, cross sections for $(\alpha,2n)$ to $(\alpha,6n)$ reactions were measured. A cross section of 60 ± 10 mb was calculated for the production of helion fragments, and the energy distribution given. An upper limit was estimated for the production cross sections of lithium and beryllium fragments. (auth)

2191

RADIATIVE PROTON CAPTURE IN Ni^{58}. J. H. Carver (Australian National Univ., Canberra) and G. A. Jones. Nuclear Phys. 19, 184-98(1960) Oct. (1). (In English)

The resonance structure of the reaction $Ni^{58}(p,\gamma)Cu^{59}$ was studied by measuring the position activity of 81 sec Cu^{59}. There were observed 153 new resonances for proton energies between 1.8 and 4.3 Mev. The results can be fitted to a level spacing formula of the form $D(U) = 3.8 \times 10^4\, U^2 \exp(-2\sqrt{5U})$ kev (U is in Mev). The nuclear temperature, and hence the slope of the D(U) curve, was in agreement with Cameron's semi-empirical formula which, however, underestimates the absolute spacings by a factor ≈15. The data were interpreted as giving the spacings of levels of all spins. The spacings of the $^5/_2^+$ and $^3/_2^+$ states of Cu^{59} are known from previous proton inelastic scattering measurements and combining the two sets of data determines the moment of inertia for Cu^{59} as 0.35 ± 0.12 of the rigid body value. The total radiation widths $g\Gamma_\gamma$ were determined for the levels with excitations U = 5 to 7.5 Mev and the average value $\overline{g\Gamma_\gamma}(U)$ was found to increase systematically with U. The photon strength function $\overline{g\Gamma_\gamma}(U)/$

$\overline{D}$(U) also increased with U. The shape, but not the absolute value, of the strength function is correctly given by a statistical calculation in which the radiative probability was determined from photodisintegration data. After removing the average energy dependence the frequency distribution of the total radiation widths $g\Gamma_\gamma/\overline{g\Gamma_\gamma}$ was found to be χ-squared with (2.9 ± 0.6) degrees of freedom. This was consistent with the Porter-Thomas theory since only a few partial radiation widths comprise the bulk of the total radiation width. (auth)

2192

M1/E2 MIXING RATIO IN THE Fe^{57} 14.41 kev γ-TRANSITION. G. T. Ewan, R. L. Graham, and J. S. Geiger (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Phys. 19, 221-4(1960) Oct. (1). (In English)

The M1/E2 mixing ratio of the 14.41 kev γ transition in Fe^{57} was deduced from a measurement of the $L_I/(L_{II} + L_{III})$ conversion line intensity ratio. The measured value $L_I/(L_{II} + L_{III}) = 10.9 \pm 0.8$ is compared with Rose's theoretical L sub-shell conversion coefficients extrapolated to 14.41 kev. This comparison indicates that the γ transition has an E2 quantum admixture of less than 10^{-4}. This limit means that there is no strong enhancement of the E2 transition probability over the single particle estimate. (auth)

2193

GAMMA RADIATION FROM INELASTIC SCATTERING OF 14-Mev NEUTRONS BY THE COMMON EARTH ELEMENTS. Richard L. Caldwell, William R. Mills, Jr., and John B. Hickman, Jr. (Socony Mobil Oil Co., Inc., Dallas). Nuclear Sci. and Eng. 8, 173-82(1960) Sept.

Gamma rays in the energy range 2 to 11 Mev produced by inelastic scattering of 14-Mev neutrons by nine elements were measured at a mean angle of 90°. Excluding carbon and oxygen, the maximum energy gamma rays varied from about 8 Mev for phosphorus to about 10.5 Mev for magnesium and 11 Mev for silicon. Resolved gamma rays were observed from carbon (4.43 Mev), oxygen (6.1 and 7 Mev), silicon (1.78 Mev), aluminum (2.2 Mev), phosphorus (2.2 Mev), sulfur (2.2 Mev), and calcium (3.7 Mev). In the energy range 4 to 6 Mev there are indications of individual gamma rays in silicon; no resolved gamma peaks above 2 Mev were observed for iron and magnesium. Except for carbon and oxygen, the intensity of gamma rays decreases with increase in energy and varies from about 3 to 9 times higher at 2 to 3 Mev than at 5 to 6 Mev. Gamma production cross sections are given for each element, relative to the known cross section for carbon. The ratio of the integrated cross section for gamma-ray production above 2 Mev to the nonelastic neutron cross section varies from 0.59 for sulfur to 0.99 for iron. (auth)

2194

LOW-ENERGY NEUTRON RESONANCES IN ERBIUM AND GADOLINIUM. H. Bjerrum Møller, F. J. Shore, and V. L. Sailor (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 8, 183-92(1960) Sept.

The two neutron resonances in Er at 0.46 and 0.58 ev were measured using samples enriched in Er^{166}, Er^{167}, and Er^{168}. It was found that both resonances occur in the target nucleus Er^{167}. The isotopic cross sections of Gd^{155} and Gd^{157} were measured from 0.02 to 0.30 ev and resonances were found in Gd^{155} at 0.0268 and in Gd^{157} at 0.0314 ev. Parameters for these resonances were derived by fitting the data to single-level Breit-Wigner formulas. Isotopic assignments were made for fifteen Gd resonances between 1 and 25 ev from previously unpublished data using samples enriched in 155, 156, 157, and 158. The Breit-Wigner parameters for three of these were obtained. (auth)

2195

MANGANESE BATH MEASUREMENTS OF η OF U^{233} AND U^{235}. R. L. Macklin, G. deSaussure, J. D. Kington, and W. S. Lyon (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 8, 210-20(1960) Sept.

The absolute thermal value of η for U^{233} and U^{235} was measured directly by a method of total absorption which involves relative counting of manganese bath activations and some minor corrections. A thermal neutron beam (defined by cadmium difference) is introduced in the center of a one-meter-diameter sphere filled with a dilute solution of manganous sulfate in water. The beam is first made to activate the bath directly, then it is totally absorbed in the fissionable sample whose fission neutrons then activate the bath. The ratio of the two activities is equal to η except for small corrections. The results obtained for η corrected to 2200 m/sec were, for U^{233}, 2.296 ± 0.010; and for U^{235}, 2.077 ± 0.010. (auth)

2196

STANDARD BORON SOLUTIONS FOR NEUTRON ABSORPTION MEASUREMENTS. S. Wexler (Argonne National Lab., Ill.). Nuclear Sci. and Eng. 8, 270-3(1960) Sept.

A procedure is described for preparing deuterated boric acid solutions for use in the absolute determination of the cross section for absorption of thermal neutrons and for reference standards. The suitability of these solutions as standards is discussed in terms of the purity of the reagents, the reproducibility of preparation, and the composition of the boric oxide used in the preparation. (auth)

2197

STUDIES ON THE ATOMIC NUCLEUS STRUCTURE WITH REACTOR "EWA." Zdzislaw Wilhelmi (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 467-80(1960). (In English)

Research programs and equipment are briefly described. Gamma spectra and thermal, epi-cadmium, and fast neutron flux measurements on a horizontal channel in the EWA reactor are given. Thermal-neutron-scattering curves are given for aluminum, silver, and bismuth; and neutron-resonance-scattering cross sections are tabulated for Al, Fe, Co, Ni, Cu, Zn, Se, Ag, and Bi. The design of an ionization chamber used in "tripartition" fission studies and a schematic of the system used in producing Ne^{23} and studying β-γ correlations are included. (D.E.B.)

2198

NEUTRON DIFFRACTION STUDIES IN SOLID STATE PHYSICS. Konrad Blinowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 481-93(1960). (In English)

The experimental methods used in neutron diffraction studies at the Institute of Nuclear Research in Warsaw are described. Results of slow-neutron spectra measurements; cold-neutron production; structural investigation of PbO, WC, and FeS_2 (magnetic structure); and study of parasitic Bragg reflections observed in the neutron spectra from crystal monochromators are presented. (auth)

2199

EXCITED NUCLEON INTERPRETATION OF HIGH ENERGY NUCLEAR INTERACTIONS. F. J. M. Farley (European Organization for Nuclear Research, Geneva). Nuovo cimento (10) 16, 210-26(1960) Apr. 16. (In English)

An analysis of the kinematics of the excited nucleon model leads to three relationships which are found to be in fair agreement with the experimental data: i) inelasticity-n_s relation; ii) backward angle-n_s relation, and iii) forward angle-primary energy relation. A simple statistical

treatment of the excited nucleon itself gives a good fit to the transverse momentum distribution in the jets. (auth)

2200

INDEPENDENT PARTICLE MODEL AND PHOTONUCLEAR GIANT RESONANCE. E. Eberle, M. Nagasaki, and L. Sertorio (Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy). Nuovo cimento (10) 16, 260-8(1960) Apr. 16. (In English)

A calculation of the Migdal mean energy of the photonuclear absorption cross section is made by using a harmonic oscillator shell model, without any complicated mathematical treatment. The conditions under which this independent particle model can give account of the behavior of the peak of the giant resonance in the photonuclear reactions are analyzed. (auth)

2201

GAMMA-RAY TRANSITIONS IN ^{155}Gd. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10) 16, 283-91(1960) Apr. 16. (In English)

Conversion coefficients of the 86 kev and 105 kev transitions following the β decay of Eu^{155} are determined to be $\alpha^K_{86} = 0.49 \pm 0.075$ and $\alpha^K_{105} = 0.29 \pm 0.054$, from studies with the intermediate image β-ray spectrometer and a scintillation spectrometer. In combination with L-subshell ratios, the mixing ratio, $\delta^2 = M2/E1$, is found to be $\delta^2_{86} < 0.04$ and $\delta^2_{105} < 0.07$. These multipolarities are discussed on the basis of the spheroidal shell model. (auth)

2202

CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG FROM BETA EMITTERS. A. Bisi, A. Fasana, and L. Zappa (Istituto di Fisica del Politecnico, Milan). Nuovo cimento (10) 16, 350-61(1960) Apr. 16. (In English)

The results of an investigation concerning the circular polarization-energy relation of the external bremsstrahlung radiation produced by β rays from various β emitters are reported. It was found that at the upper limit of the spectra the circular polarization of the EB quanta corresponds to a longitudinal polarization of β rays equal to: $-(1.05 \pm 0.04)$ v/c (P^{32}); $-(0.98 \pm 0.03)$ v/c (Y^{90}); $-(0.98 \pm 0.02)$ v/c (Tm^{170}). At the lower energy side of the spectra the circular polarization was found very high and larger than that estimated on the basis of present knowledge. Consideration is given of the attempts to ascertain how the events which occur before an EB quantum is radiated contribute to the measured polarization-energy relation. (auth)

2203

ON THE $^{198}Au^m$ ISOMERIC STATE. M. Ademollo, M. Bocciolini, G. Di Caporiacco, and M. Mandò (Istituto Nazionale di Fisica Nucleare, Florence and Università, Florence). Nuovo cimento (10) 16, 378-81(1960) Apr. 16. (In English)

The results of an investigation on the properties and production of (n,2n) and (γ,n) reactions of Au^{198m} are reported. These results are given in support of the findings of Lieshout et al. reported to the Italian Physical Society at Pavia in October 1959. An estimation was obtained of the production branching in the (n,2n) reaction, and an upper limit was found for the production of the excited state in the (γ,n) reaction. The present results indicate a more complicated decay scheme than that proposed by Lieshout et al. As an average of various runs, and by detecting γ_1, γ_2, x-line, and conversion electrons the best result for the half life is (9.8 ± 0.3) hr. (B.O.G.)

2204

ON THE INELASTIC SCATTERING BY DEFORMED NUCLEI. Z. Janković (Univ. of Zagreb and Inst. "Rudjer Bošković," Zagreb). Nuovo cimento (10) 17, 281-7(1960) Aug. 1. (In English)

A more general treatment of the nuclear inelastic scattering on even-even target nuclei is given particularly by introducing other collective target states besides rotational ones, the deformed diffuse nuclear and spin-orbit potentials, and the Coulomb potential for the deformed target nucleus. In the first-order approximation, explicit expressions for the differential cross section and for the total cross section for the transition $0 \rightarrow 2$ are deduced. (auth)

2205

INNER BREMSSTRAHLUNG-NUCLEAR RECOIL ANGULAR CORRELATION IN K-CAPTURE. S. D. Bloom and J. L. Uretsky (Univ. of California, Livermore). Nuovo cimento (10) 17, 304-15(1960) Aug. 1. (In English)

It is suggested that a measurement of the inner bremsstrahlung (IB)-nuclear recoil angular correlation in K-capture leads to a method for determining the ratio $|C_A|^2/|C_V|^2$, which is substantially free from dependence on either lifetime or spectral-shape factors in contrast to the estimates of $|C_A|^2/|C_V|^2$ made from the ft values. So far, a determination such as suggested here has been made only in the case of the β decay of aligned neutrons. In the case of Be^7, the only known super-allowed K-capturer, a similar measurement might be of considerable interest since here some fairly dependable calculations of $|M_{GT}|$, the Gamow-Teller matrix element, might be made (knowledge of $|M_{GT}|$ is essential in the evaluation of $|C_A|^2/|C_V|^2$). A general formula is derived for the IB-nuclear recoil angular correlation and applied to the particular case of the Be^7 $\xrightarrow{\text{K-capture}}$ Li^7 β decay. In addition, it is shown that the formula, which in its general form assumes an initial (arbitrary) polarization for the K-capturing nucleus, offers the possibility of doing an unambiguous time-reversal experiment by looking for a left-right asymmetry in the count rate when polarization, recoil-momentum direction, and IB-direction are all mutually perpendicular. (auth)

2206

^{8}Li FRAGMENTS ASSOCIATED WITH NUCLEAR DISINTEGRATION. A. Alumkal (Marquette Univ., Milwaukee), A. G. Barkow, G. Kane, R. E. McDaniel, Z. O'Friel. Nuovo cimento (10) 17, 316-33(1960) Aug. 1. (In English)

A preliminary report is presented on the emission of heavy fragments in nuclear disintegration. It is assumed that the probability of emission of a heavy fragment depends on the nuclear temperature (T) and the potential barrier (V) of the excited nucleus. It is the purpose of this investigation to study the dependence of the differential energy spectrum on the excitation energy. The data collected were from four stacks of Ilford G-5 emulsions, exposed to (a) a stopped pion beam, (b) 400-Mev proton beam, (c) 4 to 5-bev pion beam, and (d) cosmic rays with an exposure in Texas, magnetic latitude of 41°N, and on the Island of Guam at the magnetic equator. Emphasis is placed on the emission of Li^8 as the heavy fragment. The results of the experiment indicate that for high excitation energy there is a collimation of lithium and beryllium fragments in the forward direction, which may be explained on the basis of evaporation theory by assuming the fragment emission to take place during the flight of a highly excited nucleus. In the case of low excitation energy, the angular distribution of Li^8 fragments is isotropic and the energy distribution indicates that the majority result from the absorption of a π^--meson by a light nucleus. (auth)

2207

PHOTONEUTRONS FROM BISMUTH. V. Emma

(Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy), C. Milone, A. Rubbino, and R. Malvano. Nuovo cimento (10) 17, 365-74(1960) Aug. 1. (In English)

The energy spectrum of photoneutrons from bismuth-209 irradiated with 30-Mev bremsstrahlung is studied at ϑ angles of 30, 60, 90, 120, and 150° in nuclear emulsions. A comparison between the experimental energy spectra and an evaporative spectrum calculated according to the expression $F(E_n) = kE_n \exp[-E_n/T]$ shows a surprisingly high contribution of high-energy neutrons around $\vartheta = 90°$. The angular distribution is isotropic in the region $2 < E_n \leq 4$ Mev, is approximately of the form $1 + 0.7 \sin^2 \vartheta$ for $4 < E_n \leq 5$ Mev, and shows back and front asymmetry for $E_n > 5$ Mev. The contribution of the photoneutrons arising from the Bi(γ,2n) process is evaluated. (auth)

2208

ANGULAR DISTRIBUTIONS OF PROTONS EMITTED IN ^{24}Mg(n,p) AND ^{32}S(n,p) REACTIONS AT 14 MeV. L. Colli (Centro Informazioni Studi Esperienze, Milan and Università, Milan), I. Iori, G. Marcazzan, F. Merzari, A. M. Sona, and P. G. Sona. Nuovo cimento (10) 17, 634-43(1960) Sept. 1. (In English)

Measurements are described on angular distributions of protons from the reactions $S^{32}(n,p)$ and $Mg^{24}(n,p)$, with 14 Mev neutrons. The angular distribution is studied for a well-defined group of protons, corresponding to a level group which originate a gross-structure. Experimental results allow the following conclusions: 1) the reaction mechanism for protons in the gross-structures is a direct surface effect; 2) it is possible to determine the l values of orbits from which the proton is taken and where the neutron is captured. In both cases a part of the spectrum can be attributed to a statistical evaporation process. (auth)

2209

THE LEVELS IN ^{121}Sb STUDIED FROM THE DECAY OF ^{121}Te^{m} AND ^{121}Te. R. K. Gupta (Instituut Voor Kernphysisch Onderzoek, Amsterdam). Nuovo cimento (10) 17, 665-70 (1960) Sept. 1. (In English)

The levels in Sb^{121} were investigated from the decay of Te^{121} and Te^{121m} by single crystal NaI(Tl) spectrometer and coincidence scintillation spectrometer studies. From the coincidences between low intensity 1130 and 70 kev γ rays and between 506 and 70 kev γ rays, excited levels at 70, 575, and 1100 kev in Sb^{121} were inferred. The new level at 70 kev agrees with the systematics of $\frac{7+}{2}$ levels in this region. (auth)

2210

GHOST STATES AND PAIR EFFECTS IN THE LEE MODEL. L. M. Scarfone and W. A. McKinley (Rensselaer Polytechnic Inst., Troy, N. Y.). Nuovo cimento (10) 17, 678-86 (1960) Sept. 1. (In English)

Pauli and Källén's treatment of the one particle V-states in the ordinary Lee model is applied to J. S. Goldstein's extension of the Lee model which includes pair effects in the θ-particle. Contrary to an earlier conclusion, it is shown that there is simultaneously a ghost state in the V-spectrum with energy greater than the normal V energy as well as a ghost in the θ-spectrum for negative values of one of the renormalization constants. (auth)

2211

THE THERMAL NEUTRON ACTIVATION CROSS SECTION OF ^{105}Ru. B. L. Sharma (Ohio State Univ., Columbus). Nuovo cimento (10) 17, 687-90 Sept. 1. (In English)

To calculate the thermal neutron activation cross section of Ru^{105}, the enriched Ru^{104} was exposed to a thermal neutron flux of 1.2×10^{14} neutrons cm^{-2} s^{-1}. After the decay of the 40-day activity of Ru^{103}, the silver impurity was removed and the contributions from cobalt and europium impurities were subtracted. The γ energies and the coincidence results were consistent with the previously established results for Ru^{106}-Rh^{106}. From γ intensities consideration, the thermal neutron activation cross section of Ru^{105} was calculated to be (0.20 ± 0.02) barn. (auth)

2212

FLUCTUATIONS OF NUCLEAR CROSS SECTIONS IN THE "CONTINUUM" REGION. Torleif Ericson (Univ. of California, Berkeley). Phys. Rev. Letters 5, 430-1(1960) Nov. 1.

An examination was made of the nontrivial consequences of the statistical assumption in the continuum region in which a larger number of compound states overlap because of the short lifetime of the compound nucleus. It is shown that the proper statistical prediction for experiments performed with good energy resolution in the incident beam is that partial cross sections and angular distributions fluctuate even though a large number of intermediate states are excited, the formation and decay of the compound nucleus are independent only on the average, and the fluctuations can be used to determine the lifetime of the compound nucleus in the continuum region. It is generally concluded that the excitation of a large number of intermediate compound states automatically implies that cross sections are smooth functions of the energy and that angular distributions are symmetrical around 90° to the beam direction. (B.O.G.)

2213

LEVELS IN CO^{59}. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Proc. Indian Acad. Sci., Sec. A 52, 130-4(1960) Sept. (In English)

The β decay of Fe^{59} and Co^{59} levels was studied with an intermediate image β-ray spectrometer and a scintillation spectrometer. Kurie plots of the β spectra of Fe^{59} were made, and the spectra analysis results are tabulated. A search for internal conversion lines revealed a weak line corresponding to internal conversion in Co^{59} of a 70-kev transition, and the intensity of this line relative to the total β spectrum is 0.25 ± 0.07%. A 70-kev γ ray is also seen in the low-energy γ spectrum of Fe^{59}, and it is proposed that a 70-kev transition exists in addition to transitions at 135, 190, 330, 1100, and 1290 kev. The relative intensity of the 70-kev γ ray is $\gamma_{70}/\gamma_{135} = 0.5 \pm 0.2$ and $\gamma_{70}/(\gamma_{1100} + \gamma_{1290}) = 0.42 \pm 0.2\%$, and the 70-kev transition conversion coefficient of 0.6 ± 0.45 requires an angular momentum change of not more than two units. The 70-kev transition does not fit into the existing decay scheme and should start from another level at least 70 kev above one of the known excited states. A discussion of the Co^{59} levels is given. (D.L.C.)

2214

ON THE INELASTICALLY SCATTERED PROTON AT HIGH ENERGY. Yoshiyuki Sakamoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1205-7(1960) June. (In English)

The angular distributions of protons inelastically scattered from the 12.73- and 15.11-Mev levels in C^{12} were calculated and compared with experimental data; the agreement is fairly good. In the case of the 15.11-Mev level, for which scattered proton polarization was also calculated, the calculations were made on the basis of Gammel-Thaler two-body scattering phase shifts and substitution of the experimental radiation width to the ground state for the matrix element corresponding to the magnetic dipole transition. It is concluded that observations of protons inelastically scattered from nuclear levels may be useful in fixing the isotopic spin of the levels and the isotopic spin flip of the residual nucleus. (D.L.C.)

2215

POLARIZATION IN HEAVY PARTICLE STRIPPING. M. A. Nagarajan (Saha Inst. of Nuclear Physics, Calcutta). Progr. Theoret. Phys. (Kyoto) 23, 1214-16(1960) June. (In English)

The polarization of outgoing particles in deuteron stripping reactions is calculated from the heavy particle stripping mechanism and found to be large. It is concluded that the contribution of heavy particle stripping to the polarization must be calculated in addition to direct stripping and that its relative importance can be judged only after evaluating the radial integrals. (D.L.C.)

2216

ISOTOPE SHIFTS IN CADMIUM SPECTRAL LINES. N. R. Batarchukova. Vestnik Leningrad. Univ. 14, No. 16, Ser. Fiz. i Khim. No. 3, 10-14(1959). (In Russian)

With enriched samples of Cd^{112}, Cd^{114}, and Cd^{116} in electrodless discharge tubes, measurements were made of isotope shifts in four lines of the visible spectrum. The position of the center of gravity of the 6438A line for different samples enriched in Cd^{114} was determined by a graphical method. The maximum shift of the center of gravity was equal to 0.0022 cm^{-1}, with a probable error of 0.0002 cm^{-1}. (auth)

2217

Lu^{176} SPIN DETERMINATION BY PHOTOELECTRIC MEASUREMENTS. N. I. Kaliteevskii and M. P. Chaika. Vestnik Leningrad. Univ. 14, No. 16, Ser. Fiz. i Khim. No. 3, 51-60(1959). (In Russian)

The ratio of the hyperfine structure component intensities of the line Lu(II) λ 6463A was measured by the photoelectric method. The spin I = 7 of Lu^{176} was determined using a sample enriched in that isotope. (auth)

2218

REACTIONS BETWEEN COMPLEX NUCLEI. Proceedings of the Second Conference on Reactions Between Complex Nuclei, May 2-4, 1960, Gatlinburg, Tennessee. Alexander Zucker, Frederick T. Howard, and Edith C. Halbert, eds. New York, John Wiley & Sons, Inc. 1960. 338p. $7.00.

Forty papers are included. Also included are transcripts of the discussion following each paper and a summary of the conference. The papers are grouped in five sections: transfer reactions; Coulomb excitation; scattering; transuranium, fission, and low energy Li reaction; and compound nucleus reactions. Thirty seven of the papers are covered by separate abstracts. The three remaining papers were previously abstracted in Nuclear Science Abstracts. (M.C.G.)

2219

NUCLEON TRANSFER THEORY. G. Breit (Yale Univ., New Haven). p.1-15 of "Reactions Between Complex Nuclei."

The reliability of reduced widths obtainable from nucleon transfer experiments are discussed. The uncertainties in the interpretation are those of calculating the probability of a particle being transferred through a region of negative kinetic energy (tunneling) if the virtual Coulomb excitation is neglected. The approximation for the motion of the transferred nucleon may be solved for the special case in which a particle is exposed to the action of two δ-function potentials. The important thing for nucleon transfer is the proximity of neutrons to the receiving nucleus, and not simply the cross section for photodisintegration. Because of the difficulty of making reliable estimates of virtual Coulomb excitation, its possible entrance in the reaction is discussed. Measurements of total cross section for N^{14} bombardments of Be^9, B^{10}, C^{12}, N^{14}, O^{16}, Na^{23}, Mg^{24}, Mg^{25}, Mg^{26}, Al^{27}, and S^{32} are discussed together with applicability of the tunneling theory to these reactions. (M.C.G.)

2220

NEUTRON-TRANSFER REACTIONS FROM BOMBARDMENTS WITH 124-Mev C^{12} IONS AND 145-Mev N^{14} IONS. E. L. Hubbard and G. Merkel (Univ. of California, Berkeley). p.25-9 of "Reactions Between Complex Nuclei."

The energy and angular distributions of N^{13} produced when copper and silver targets were bombarded with 145 Mev N^{14} ions were measured. Similar energy and angular distribution measurements were obtained for C^{11} nuclei produced with 124 Mev C^{12} bombardments. The energy distributions of the N^{13} and C^{11} ions indicated that the major portion of the ions could not be due to simple particle emission by Coulomb excitation. Results also indicated that the explanation for the different angular distributions could be based on a significantly greater E2 contribution in the $N^{14}(\gamma,n)N^{13}$ reaction than in the $C^{12}(\gamma,n)C^{11}$ reaction. (M.C.G.)

2221

GRAZING AND MULTINUCLEON TRANSFER REACTIONS OF HEAVY IONS. Richard Haufmann and Richard Wolfgang (Yale Univ., New Haven). p.30-41 of "Reactions Between Complex Nuclei."

Multinucleon transfer processes were investigated to provide evidence for the occurrence of grazing reactions of high-energy heavy ions. Angular distributions of several products were measured from the bombardment of a rhodium target with C^{12}, N^{14}, O^{16}, and F^{19} beams. Products were detected by observations of the positron annihilation of γ rays. Reduced energy beams of O^{16} were used to determine excitation functions. All possible mechanisms of multinucleon transfer are discussed. The grazing collision appeared to be the most likely method for contact transfer of nucleons. Single nucleon transfer results were also obtained. (M.C.G.)

2222

ANGULAR DISTRIBUTION OF N^{13} FROM N^{14} ON N^{14}. K. S. Toth (Oak Ridge National Lab., Tenn.). p.42-6 of "Reactions Between Complex Nuclei."

The angular distribution of N^{13} produced by bombarding N^{14} with N^{14} ions accelerated to about 28 Mev was obtained for those N^{13} ions that left N^{15} in its ground state. Aluminum absorber foils were placed in front of the catcher foils to stop the undesired N^{13} nuclei. The amount of N^{13} produced was determined by graphically analyzing decay curves. The distribution indicated that the reaction proceeded by means of neutron transfer. Excessive absorber thickness and thick targets did not seem to account for any loss of desired N^{13} nuclei at large angles. (M.C.G.)

2223

COULOMB EXCITATION WITH Ne^{20} IONS. P. H. Stelson and F. K. McGowan (Oak Ridge National Lab., Tenn.). p.47-56 of "Reactions Between Complex Nuclei."

The modifications used for accelerating Ne^{20} ions in a Van de Graaff accelerator are described. The K-shell vacancy intensity of W^{186} was measured by bombardment with Ne^{20} ions. Angular distributions were measured for Ne^{20} bombardments of Na^{23}, Mn^{55}, F^{19}, and Li^7. (M.C.G.)

2224

COULOMB EXCITATION IN NUCLEI FROM A = 23 TO A = 60 USING O^{16} IONS. H. E. Gove and C. Broude (Atomic Energy of Canada, Ltd., Chalk River, Ont.). p.57-66 of "Reactions Between Complex Nuclei."

Oxygen ions of energy up to 36 Mev were used to measure reduced electric quadrupole transition probabilities by

Coulomb excitation in Na^{23}, Al^{27}, Mg^{24}, Si^{28}, V^{51}, Mn^{55}, Fe^{56}, Ni^{58}, and Ni^{60}. The energy of the level excited in each nucleus, the spins of ground and excited states, the values obtained for the reduced transition probability for excitation, and the E2 enhancement factor are given. The quadrupole moments calculated from this data are also given. (M.C.G.)

2225

DISINTEGRATION OF Li^6 IN COLLISIONS WITH GOLD NUCLEI. Carl E. Anderson (Yale Univ., New Haven). p.67-76 of "Reactions Between Complex Nuclei."

The Yale Heavy-Ion Accelerator and other equipment used in the study of Li^6 collisions with gold nuclei are described. Gold targets were bombarded with Li^6 to see if a process similar to the electric breakup of the deuteron might occur. The range-energy relation of Li^6 in aluminum, the material used for degrading beam energy, and the pulse-height response of CsI to the ions were determined. The angular and energy distributions of α particles, deuterons, and protons obtained by bombarding a gold target with Li^6 ions at 38.0, 42.7, 60.6, and 62.8 Mev are given. It was concluded that Coulomb excitation may explain most of the observed data, but such theories as nuclear stripping cannot be excluded. (M.C.G.)

2226

COULOMB DISINTEGRATION OF Li^6 BY HEAVY NUCLEI. R. L. Gluckstern and G. Breit (Yale Univ., New Haven). p.77-85 of "Reactions Between Complex Nuclei."

An attempt was made to determine the participation of Coulomb excitation in the disintegration of Li^6 in its collisions with Au^{197}. After Coulomb excitation to the 3^+ level at 2.184 Mev, the state then decays into an α particle and a deuteron. The energy spectra and angular distribution of the alpha particles are given along with the differential cross section for quadrupole excitation. (M.C.G.)

2227

COULOMB EXCITATION PRODUCED BY OXYGEN IONS. B. M. Adams, D. Eccleshall, and M. J. L. Yates (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). p.95-101 of "Reaction Between Complex Nuclei."

Oxygen ions with energies up to 39 Mev from the tanden Van de Graaff accelerator were used to study Coulomb excitation. Results of single or direct excitation are given for Si^{28}, Cr^{52}, Fe^{56}, V^{51}, and Co^{59}. The stopping powers for the oxygen ions were calculated from the stopping power of protons having the same velocity as the oxygen ions and from the average charge state of the oxygen ions at that velocity. Double Coulomb excitation was studied using Sm^{152}, Sm^{154}, and W^{186} as targets. (M.C.G.)

2228

COULOMB EXCITATION WITH HEAVY IONS. B. Elbek, G. Igo, F. S. Stephens, Jr., and R. M. Diamond (Univ. of California, Berkeley). p.102-11 of "Reactions Between Complex Nuclei."

Three types of studies were carried out in the Coulomb excitation program. The Coulomb excitation of the projectile ions themselves was investigated. Theoretical and experimental excitation functions are given for the 1.63 Mev 2^+ level in Ne^{20}. The rotational levels of the deformed nuclei, U^{238}, Th^{232}, and W^{182} were studied by Coulomb excitation. Multiple quadrupole excitation was found to be much more likely than the direct higher multipole transition itself for excitation of heavy-element targets by heavy ions at an energy near the Coulomb barrier. The excitation of the higher energy levels in deformed nuclei including the β and γ vibrational bands and odd-parity states were studied using O^{16}. Results of studies with U^{238} indicated E3 excitation to odd-parity levels around 660 kev. (M.C.G.)

2229

INVESTIGATION OF THE COULOMB EXCITATION OF NUCLEI BY MEANS OF MULTIPLY CHARGED IONS. I. Kh. Lemberg (Leningrad Physical-Technical Inst., Academy of Science). p.112-26 of "Reactions Between Complex Nuclei."

The advantages of using multiply charged ions for the investigation of the Coulomb excitation of nuclear levels are shown. As a result of a systematic study of the γ spectra registered in experiments with more than 40 different elements and their compounds, it was concluded that the observed background lines were emitted in nuclear reactions of the incident heavy particles with the carbon and oxygen present in the target as impurities. Multiply charged ions of N, Ne^{20}, Ne^{21}, Ne^{22}, C^{12}, and O^{16} were used in the investigation. The targets studied were Ne, Mg, Si, Ti, Cr, Ni, Zn, Se, Zr, Nd, Al, P, S, Sc, V, Mn, Nb, Sn, and Pr. The use of heavy ions made it possible to obtain data on the high energy levels of these targets. It was also possible to investigate Coulomb excitation in cases where targets had to be made from oxides or salts. (M.C.G.)

2230

SMALL-ANGLE SCATTERING OF HEAVY NUCLEI. J. S. McIntosh, S. C. Park, and G. H. Rawitscher (Yale Univ., New Haven). p.127-37 of "Reactions Between Complex Nuclei."

An attempt was made to calculate an optical model for scattering of heavy nuclei by heavy nuclei for internuclear distances such that the two nuclei do not overlap appreciably. These calculations were made from the known nucleon-nucleus optical potential. To determine how uniquely the tail of the real part of the potential can be determined from experimental angular distributions, various arbitrary modifications were made of both the real and imaginary parts of the potential. Their effects on the scattering cross sections of 20 Mev nitrogen nuclei on identical and nonidentical targets were calculated for comparison with previous data. (M.C.G.)

2231

SCATTERING AND REACTIONS INVOLVING LITHIUM ION BEAMS. J. M. Blair (Univ. of Minnesota, Minneapolis). p.138-43 of "Reactions Between Complex Nuclei."

Measurements were made of Li^7-Li^7 elastic scattering by observing in coincidence the two lithium ions at 45° with respect to the incident beam. The ratio of observed scattering to Mott scattering was determined over the range 2.8 to 3.7 Mev. The average charge of the lithium ion after passing through the target foil was also determined. The angular distribution of α particles produced by the bombardment of beryllium targets with Li^6 ions at 3.25 and 3.50 Mev was determined. The cross section for this reaction was calculated as a function of angle in the center-of-mass system. (M.C.G.)

2232

ELASTIC SCATTERING OF NITROGEN FROM LIGHT ELEMENTS. A. Zucker and M. L. Halbert (Oak Ridge National Lab., Tenn.). p.144-50 of "Reactions Between Complex Nuclei."

The elastic scattering of 28 Mev nitrogen ions was studied for Be, C, N, and Al targets. Three approaches, a sharp cutoff model, a newly developed rainbow model, and an optical model, were used to analyze this low-energy scattering. Differential cross sections and the ratio of elastic to Coulomb scattering cross sections were determined for nitrogen scattering by aluminum and car-

bon and carbon scattering by gold. A comparison was made of theoretical calculations and experimental results. (M.C.G.)

2233

HEAVY-ION REACTION MECHANISMS. ELASTIC SCATTERING DATA. D. A. Bromley, J. A. Kuehner, and E. Almqvist (Atomic Energy of Canada, Ltd., Chalk River, Ont.). p.151-63 of "Reactions Between Complex Nuclei."

Elastic scattering of O^{16} and C^{12} ions from several target elements were investigated. At energies below the Coulomb barrier, the energy and angle dependence of the cross sections was in excellent agreement with Mott predictions. At higher energies the measurements agreed with those calculated from the Blair model. In measurements of carbon on carbon, marked resonance structure was found which led to the postulation of a quasi-molecular potential for the C^{12} interactions that may be dependent on the deformability of the C^{12} nucleus. (M.C.G.)

2234

INELASTIC SCATTERING OF NITROGEN-14 BY CARBON-12. M. L. Halbert and A. Zucker (Oak Ridge National Lab., Tenn.). p.164-6 of "Reactions Between Complex Nuclei."

It was found that scattering to the 4.43 Mev state of C^{12} with the N^{14} left in the ground state is by far the predominate process in the inelastic scattering of N^{14} by C^{12}. It was also found that the inelastic scattering structure is quite subdued in comparison with the structure in the elastic scattering. The angular distributions were similar to those obtained by inelastic scattering of α particles and deuterons from the same level in the carbon. Results indicated that there was no significant contribution to the scattering owing to Coulomb excitation because the magnitude of the cross sections predicted by theory was too small by a factor of 15. (M.C.G.)

2235

ELASTIC SCATTERING OF HEAVY IONS BY GOLD, LEAD, AND BISMUTH. D. D. Kerlee (Seattle Pacific Coll. Inst. for Research, Seattle), H. L. Reynolds, and E. Goldberg. p.167-74 of "Reactions Between Complex Nuclei."

The elastic angular distributions of C^{12}, N^{14}, O^{16}, and Ne^{20} projectiles on targets of Au^{197}, Pb^{206}, Pb^{207}, Pb^{208}, and Bi^{209} were investigated. The projectiles had an energy of approximately 10.4 Mev/nucleon. The ratio of differential cross sections for elastic scattering to the Coulomb cross sections was calculated as a function of center-of-mass angle. Cutoff values and nuclear interaction distances were inferred from a sharp cutoff model. (M.C.G.)

2236

ELASTIC SCATTERING OF C^{12} IONS FROM SEVERAL NUCLEI. J. Alster and H. E. Conzett (Univ. of California, Berkeley). p.175-9 of "Reactions Between Complex Nuclei."

The elastic scattering of C^{12} by Ni, Ag^{107}, In, and Ta was investigated using 124.5 Mev C^{12} ions. Angular distributions were calculated. The rise above the Coulomb cross sections varied from 15 to 30%. The Blair sharp-cutoff model was used with some modifications for an analysis of the data. (M.C.G.)

2237

ELASTIC SCATTERING OF VARIOUS NUCLEI FOR A FIXED COULOMB INTERACTION. J. A. McIntyre, S. D. Baker, and K. H. Wang (Yale Univ., New Haven). p.180-7 of "Reactions Between Complex Nuclei."

The magnitude of the effects in a scattering process that can be expected owing to changes in nuclear parameters were investigated. The angular distributions obtained for the scattering of nuclei by nuclei were examined. Large changes in the magnitude of the diffraction oscillations were found to have little to do with nuclear parameters such as radius and surface thickness, but they depend on the strength of the Coulomb interaction between the nuclear charges. Calculation of scattering from a hypothetical nucleus was made for the values of the Coulomb interaction parameter. Results obtained for O^{16} scattered by Pb^{208} and F^{19} scattered by Tb^{159} are given. (M.C.G.)

2238

ELASTIC SCATTERING FROM LIGHT GASES. E. Newman, P. G. Roll, and F. E. Steigert (Yale Univ., New Haven). p.188-94 of "Reactions Between Complex Nuclei."

The elastic scattering of O^{16} from gaseous targets of He^4, N^{14}, O^{16}, and Ne^{20} and the scattering of C^{12} from nitrogen were studied at energies of 10 Mev/nucleon. Two additional observations of the $O^{16}-O^{16}$ elastic scattering at energies of approximately 6 and 8 Mev/nucleon were also made. Absolute differential cross sections were determined as a function of center-of-mass angle, and a compilation was made of non-identical particle scatterings with the results expressed as the ratio of the observed to the Rutherford cross sections. Only one attempt was made to fit these data with a sharp-cutoff calculation. This was for the case of $O^{16}-N^{14}$ scattering. (M.C.G.)

2239

RECENT RESEARCH WITH THE HEAVIEST ELEMENTS. Albert Ghiorso (Univ. of California, Berkeley). p.195-200 of "Reactions Between Complex Nuclei."

A status report is given on heavy element work at the Lawrence Radiation Laboratory. The principle used in the work is that heavy-ion transmutation knocks ions out of a target into a gas. The positively charged ions are pulled down onto a belt moving at constant speed. Then when the unstable atoms undergo α decay, some of the residual charged atoms are collected on a catcher foil placed just above the belt. By analyzing the activity in each of five sections of the foil, the half life of the parent atom can be determined. The half life and α decay energies of element 102 were determined. Pu^{240} was bombarded with C^{12} ions to make Fm^{248}, which decayed by α emission to Cf^{244}. In a search for the 3 sec isotope 102^{254}, both α particles of 8.3 Mev and spontaneous fissions with 3 sec half lives were discovered. It was not proved that any of these go with mass number 254. Work on producing element 103 and proving its existence is described. Californium was used as the target and B^{11} as the bombarding ion in this study. (M.C.G.)

2240

FISSION STUDIES WITH CARBON AND OXYGEN BEAMS. H. C. Britt and A. R. Quinton (Yale Univ., New Haven). p.201-7 of "Reactions Between Complex Nuclei."

In an investigation of fission from heavy-element bombardment with carbon and oxygen beams, the fission fragments were detected and their energies measured. The targets used were gold and bismuth. The shapes of the energy spectra of the fragments from the various reactions studied were all found to be similar. The energy spectra from the carbon bombardment of bismuth showed no significant variation with incident energy either in shape or peak position. The variation of the fission cross section with bombarding energy and the angular distribution of fission fragments for the carbon–bismuth reaction were determined. The cross section for the fission of U^{238} by 42 Mev He^4 also was measured. The angular distribution of fission fragments from bombardment of gold by 126

Mev carbon nuclei and 168 Mev oxygen nuclei and of bismuth by 168 Mev oxygen nuclei was measured. (M.C.G.)

2241

HEAVY-ION-INDUCED NUCLEAR FISSION. A. E. Larsh, G. E. Gordon, T. Sikkeland, and J. R. Walton (Univ. of California, Berkeley). p.208-15 of "Reactions Between Complex Nuclei."

The angular distributions, kinetic energy release, and total cross sections for fission of Au^{197} and natural uranium by carbon ions were studied with gas scintillation chambers and silicon p-n junction detectors. Angular distributions were obtained at bombarding energies of 72.4, 93.3, and 123.3 Mev. The experimental data were fitted with the theoretical curves of Halpern and Strutinski. From the results it appeared that fission takes place at approximately the same excitation energy regardless of the excitation energy of the original compound nucleus. The excitation function for the fission of gold with carbon ions is given. The total fission cross section increased from a value of 100 mb at 68 Mev to 1.28 barns at 124 Mev. Incomplete transfer of linear momentum to the fissioning system indicated that in some cases fission results from noncompound-nucleus reactions. (M.C.G.)

2242

INTERMEDIATE-ENERGY FISSION OF NUCLEI IN THE RADIUM REGION PRODUCED BY HEAVY-ION BOMBARDMENT. Kenneth M. Clarke (Yale Univ., New Haven). p.216-23 of "Reactions Between Complex Nuclei."

The symmetry character of mass distributions of fissioning nuclei in the radium region was investigated at excitation energies comparable to that for which the triple-peak distribution was observed. Such fissioning species differed from those produced previously in that they were more neutron dificient. To obtain the required knowledge of excitation energies, the following reactions were studied: $Pb^{208}(C^{12},xnf)$ and $Bi^{209}(C^{12}, xnf)$ at C^{12} bombarding energies near the Coulomb barrier. The compound nucleus system produced under these circumstances had a maximum excitation energy of about 28 Mev if there was no neutron evaporation prior to fission. The observed range distributions at all angles were in general consistent with a Gaussian distribution. Also it was found that the fraction of the total number of fission events having the most probable range i.e., having fission fragments of approximately equal mass was about 23%. The most probable range decreased in proportion to the average total kinetic energy release in fission. (M.C.G.)

2243

FISSION INDUCED IN GOLD WITH CARBON IONS. V. E. Viola (Univ. of California, Berkeley), H. M. Blann, and T. D. Thomas. p.224-9 of "Reactions Between Complex Nuclei."

The mass and charge distributions of fission fragments induced by 112 Mev carbon ions on gold were investigated at bombarding energies from 79 to 125 Mev. Independent yields for more than 30 fission products and cumulative yields for several others were measured by radiochemical and mass spectrometric methods. Angular distributions of the fission fragments were measured. The energy and angular momentum spectra were calculated for nuclei resulting from the evaporation of one neutron from an initial nucleus having a given excitation energy and distribution of spins. (M.C.G.)

2244

FISSION OF GOLD, LEAD, AND BISMUTH BY HEAVY IONS. E. Goldberg (Univ. of California, Livermore), H. L. Reynolds, and D. D. Kerlee. p.230-5 of "Reactions Between Complex Nuclei."

A series of experiments were carried out involving fission of nuclei by heavy ions. The reactions were $C^{12} + Au^{197}$; C^{12}, N^{14}, O^{16}, and $Ne^{20} + Pb^{208}$; and N^{14} and $Ne^{20} + Bi^{209}$ at energies of 10.4 Mev/nucleon. The absolute cross sections were determined by reference to the elastic scattering data in the same plates. Fission fragment range spectra were measured every 10° from 20 to 170°. The energies were found by using a range-energy curve recommended by Swiatecki. The fission cross sections were all similar in magnitude and ranged from 1.5 to 1.8 barns. Comparison with the reaction cross section inferred from the elastic scattering data showed a slight variation from $\sigma_f/\sigma_r \cong 0.75$. (M.C.G.)

2245

RADIOACTIVITIES INDUCED BY LITHIUM IONS. Edwin Norbeck (Univ. of Minnesota, Minneapolis). p.236-40 of "Reactions Between Complex Nuclei."

A study was made of one of the final products of a nuclear reaction by looking at emitted β particles. Thick-target yields were determined as a function of energy for lithium reactions with Be^9, Li^7, C^{12}, N^{14}, F^{19}, and Na^{23} targets. The general trend was for steeper yield curves for targets presenting larger Coulomb barriers. The angular distribution of Li^7 from the reaction $Be^9(Li^7,Li^8)Be^8$ was studied with Li^7 beam energies between 1.7 and 4.0 Mev. (M.C.G.)

2246

EXPERIMENTS AT SACLAY WITH 2-MEV LITHIUM IONS. S. M. Shafroth (Centre d'Etudes Nucléaires, Saclay, France). p.241-5 of "Reactions Between Complex Nuclei."

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, as abstract No. 20735.

2247

NUCLEAR REACTION PRODUCTS FROM THE LITHIUM BOMBARDMENT OF Li^7 AND Li^6 TARGETS. G. C. Morrison and M. N. Huberman (Univ. of Chicago). p.246-55 of "Reactions Between Complex Nuclei."

The angular distributions of the reaction products from bombardments by Li^7 and Li^6 ions were studied at an incident energy of 2.1 Mev. Relative cross sections were obtained by means of a monitor detector located at a fixed angle to the beam direction. The reactions $Li^6 + Li^7 \rightarrow B^{11} + d + 7.20$ Mev, $Li^7 + Li^7 \rightarrow B^{11} + t + 6.20$ Mev, and $Li^6 + Li^6 \rightarrow B^{11} + p + 12.23$ Mev were studied. Results indicated that the Li^6 and Li^7 projectiles behave preferentially as having (α + d) and (α + t) substructures in their nuclear interactions. Alpha particle capture seemed to be a preferred mode of interaction. It appeared that heavy particle-stripping considerations together with a "cluster" model of the nucleus are capable of explaining the observed isotopic spin conservation in the $Li^6(Li^6,d)B^{10}$ reaction. (M.C.G.)

2248

LIGHT PARTICLES FROM NITROGEN-INDUCED REACTIONS. C. E. Hunting (Oak Ridge National Lab., Tenn.). p.257-62 of "Reactions Between Complex Nuclei."

Proton energy spectra were obtained from reactions induced in a F^{19} target by 27.6 Mev N^{14} ions. The observed proton energies were converted to channel energies in the center-of-mass system according to the reaction $F^{19}(N^{14},p)P^{32}$. The channel energy was then subtracted from the ground-state channel energy for that reaction yielding the excitation energy of the residual nucleus P^{32}. The results were compared with the predictions of the compound nucleus theory. The angular distribution of the protons confirmed the prediction of symmetry about 90°.

There appeared to be no evidence that protons from the bombardment of F^{19} by N^{14} are emitted by other than compound nucleus processes. (M.C.G.)

2249

LIGHT PARTICLES EMITTED IN HIGH-ENERGY REACTIONS BETWEEN COMPLEX NUCLEI. William J. Knox (Yale Univ., New Haven). p.263-70 of "Reactions Between Complex Nuclei."

Measurements were made of the energy spectra and angular distributions of α particles, protons, and neutrons emitted in the bombardment of nickel by oxygen ions at 160 Mev and of α particles emitted in the bombardment of gold by oxygen ions. Alpha particles with energies near the peak of the energy distribution were distributed approximately symmetrically around 90°. However, there appeared to be some peaking at forward angles at all energies, and the highest energy alphas were predominately forward-peaked. The energy and angular distributions indicated that most of these α particles were produced in a mechamism consisting of compound nucleus formation followed by the evaporation of particles. The neutron energy spectra were Maxwellian at backward angles up to 12 or 14 Mev. The energy spectra for the α particles from oxygen bombardment of gold were similar to those of the oxygen–nickel reaction. (M.C.G.)

2250

RECOIL STUDIES OF HEAVY-ION-INDUCED NUCLEAR REACTIONS. J. M. Alexander and L. Winsberg (Univ. of California, Berkeley). p.271-8 of "Reactions Between Complex Nuclei."

A study was made of the recoil range and range straggling of the heavy fragments formed in heavy-ion-induced nuclear reactions. The reactions studied included those in which various elements were bombarded to form the particular product Th^{149} and those in which other targets were bombarded to form astatine and polonium. The straggling parameters deduced from experiments are given as a function of the reciprocal of the observed range. The range straggling that resulted from nuclear reaction effects was estimated. It was found that (heavy ion, xn) reactions may proceed by something other than a complete compound nucleus formation. (M.C.G.)

2251

REACTIONS OF CARBON IONS WITH TANTALUM. A. M. Friedman and D. Henderson (Argonne National Lab., Ill.). p.279-81 of "Reactions Between Complex Nuclei."

A set of weighed tantalum foils was bombarded in the carbon ion beam of the Yale Heavy-Ion Accelerator. The resulting particles were identified by their γ spectra and half lives and by the chemical behavior of the products on an anion exchange column. The products identified were Pt^{188}, Pt^{189}, Ir^{185}, Ir^{186}, and Re^{184}. The shape of the calculated curves fit the measured values well at the high-energy side of the peaks, but in all cases there was a broadening and tailing on the low-energy side of the peak. (M.C.G.)

2252

HEAVY-ION REACTION MECHANISMS. REACTION EXCITATION CURVES. E. Almqvist, D. A. Bromley, and J. A. Kuehner (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.282-90 of "Reactions Between Complex Nuclei."

The reaction yields resulting from C^{12} and O^{16} bombardment of a number of light elements were measured. The chief purpose in making these measurements was to take advantage of the high-energy resolution and variable-energy facility of the tandem accelerator to look for resonances in heavy-ion reactions. Only very preliminary attempts were made to sort out reaction details. It was found that C^{12} on C^{12} reactions are unique in showing prominent resonances. Alpha particle excitation curves were measured with Au–Si surface-barrier detectors. Gamma spectra were measured with a NaI crystal. Schematic representations of reaction channels are given for C^{12} on C^{12}, C^{12} on Ne^{20}, and O^{16} on O^{16}. Excitation curves are given for C^{12} on N, O, F, C^{12}, and Ne and for O^{16} on Ne and O^{16}. (M.C.G.)

2253

A "MOLECULE" FORMED BY TWO CARBON NUCLEI. H. McManus and E. Vogt (Atomic Energy of Canada, Ltd., Chalk River, Ont.). p.291-6 of "Reactions Between Complex Nuclei."

The sharp resonance structure in both reaction cross sections and elastic scattering of C^{12}–C^{12} collisions may be explained by "molecular" states in which both C^{12} nuclei retain their identities for appreciable periods with relative motion over large distances. When two C^{12} nuclei come into contact, they move at first into a shallow real potential well. This gives rise to a saddle point energy tending to keep them in contact. Only at smaller separations are the two nuclei strongly absorbed into the compound states of Mg^{24}. (M.C.G.)

2254

DI-NUCLEUS MODEL FOR SCATTERING OF COMPLEX NUCLEI. R. H. Davis (Florida State Univ., Tallahassee). p.297-300 of "Reactions Between Complex Nuclei."

As the impact parameter in grazing collisions is reduced, absorption of the incident flux rapidly becomes complete. Scattering at larger impact parameters yields the interference effects predicted by the Blair model. For impact parameters approximately equal to those for a grazing collision, attractive and repulsive forces cancel, permitting the formation of a di-nucleus. This model was applied to the case of carbon–carbon scattering. (M.C.G.)

2255

ANGULAR-MOMENTUM EFFECT ON EVAPORATION PROCESS. T. Kammuri (Osaka Univ.) and R. Nakasima. p.301-4 of "Reactions Between Complex Nuclei."

The effects of angular momentum on the evaporation process in heavy-ion-induced reactions were investigated. The energy spectra were calculated for neutrons emitted from $V^{51}(N^{14},n)Zn^{64}$ reactions. The one-neutron emission was found to be predominant compared with the emission of two or more neutrons because the first neutron is emitted with a large kinetic energy. The excitation functions of $V^{51}(N^{14},3n)Zn^{62}$ and $Cu^{65}(p,3n)Zn^{63}$ were compared. (M.C.G.)

Particle Accelerators

2256 NP-9166(p.252-6)

India. Atomic Energy Establishment, Trombay.

A NOTE ON THE STORAGE RING PULSER. B. V. Joshi.

A storage ring pulser for neutron pulses of very high intensity is designed in conjunction with a 1-Mev accelerator, the neutrons being produced by a beryllium target bombarded with deuterons. The deuteron beam from the accelerator is injected into the pulser where it is forced into orbit by a magnetic field and then extracted by deflection plates for bombarding the target. Injection of the beam into the pulser in a direction tangent to the equilibrium orbit is accomplished by a method suggested by L. C. Teng, viz., deflection plates coupled with forced oscillation of the beam in such a manner that its maximum outward displacement is at right angles to the injector position. For an orbital radius of 20 cm and a magnetic flux of 10,200 gauss, the

pulse duration is 130 msec for deuterons; and the peak neutron burst intensity is $\sim 10^{14}$ neutrons/msec. (D.L.C.)

2257 NP-tr-478

A UNIVERSAL ION-ELECTRON SOURCE FOR VAN DE GRAAFF GENERATORS. (Über eine Universal-Ionen-Elektronen-Quelle für Van-de-Graaff-Generatoren.) M. von Ardenne and S. Schiller. Translated by F. Hudswell (U.K.A.E.A. Atomic Energy Research Establishment) from Kernenergie 2, 893-9(1959). 22p. (Includes original, 5p.). JCL.

A universal ion-electron source for Van de Graaff generators is described; it has the advantage that it can be changed over from one to the other type of charge carrier by means of a few simple switching actions. The source yields, according to choice, a hydrogen ion emission current of 250 μa or an electron emission current of 250 μa. When operating as an ion source, this generator has an effiency $\eta \sim 0.02$, as a result of the specifically arranged action. The ratio of atomic ions to the sum of the hydrogen ions is about 0.6 in this instance. (auth)

2258

PRE-BREAKDOWN CONDUCTION IN CONTINUOUSLY-PUMPED VACUUM SYSTEMS. W. K. Mansfield (Queen Mary Coll., London). Brit. J. Appl. Phys. 11, 454-61(1960) Oct.

Measurements were made under impulse conditions of the coefficients A′, the number of H^+ ions emitted per 250 kev H^- ion, and B′, the number of H^- ions emitted per 250 kev H^+ ion, for metal surfaces covered with the contaminating layers likely to be formed in continuously-pumped high-voltage apparatus. The values obtained for A′ were 1.0, 1.1, and 0.54 and for B′ 0.43, 0.24, and 0.44 for copper, aluminum, and steel targets, respectively. The product of these coefficients is such that it makes very probable the hypothesis that pulse discharge conduction in these systems is due to the regenerative exchange of positive and negative ions of hydrogen. The transient nature of this form of conduction is thought to be due to the charging up of the insulating contaminant. (auth)

2259

A CIRCULATING SYSTEM FOR ELECTRON IRRADIATIONS. W. S. Guentner and T. J. Hardwick (Gulf Research and Development Co.,[Harmarville, Penna.]). Ind. Eng. Chem. 52, No. 11, 50A-52A; 54A(1960) Nov.

Equipment for use in conjunction with an electron accelerator in which liquids may be irradiated at constant temperature and under pressure is described. The apparatus in this recirculating system consists of four units: an irradiation cell, a degassifier, a heat exchanger, and a circulating pump. The irradiation cells have essentially the shape of a condenser with a thin outer wall and are made of aluminum and stainless steel. The normal operation of the accelerator required a continuous collection of the electrical charge absorbed in the loop. Quantitative measurements were made of the energy absorbed in the irradiated liquid for a known total electron change and operating voltage. (M.C.G.)

2260

TANDEM ELECTROSTATIC ACCELERATORS. R. J. Van de Graaff (Massachusetts Inst. of Tech., Cambridge). Nuclear Instr. & Methods 8, 195-202(1960) Aug. (In English)

In this type of accelerator a constant potential is applied to the acceleration of the ion beam, however, not as conventionally with just one voltage application, but instead with a number of applications made in succession by means of a tandem arrangement of high-voltage tubes. This number of voltage applications, which is the number of the so-called "stages" of a tandem accelerator, may be two, three, or four, depending on the design chosen. The principles of this type of accelerator are described, and a brief account is given of the design and performance tests of a two-stage accelerator for an output rating of 10 Mev and 0.5 μa of protons. Some possibilities for future development are discussed for reaching greater energies by means of three and four-stage tandem arrangements. Preliminary experimental results show the feasibility of operating these by means of the injection of a beam of neutral particles, thus retaining the use of an external ion source at ground potential, as in the present two-stage tandem accelerators. (auth)

2261

ENERGY DEGRADING-FOCUSING OF CYCLOTRON BEAM. W. J. Ramler, J. L. Yntema, and M. Oselka (Argonne National Lab., Ill.). Nuclear Instr. & Methods 8, 217-20(1960) Aug. (In English)

The Argonne National Laboratory 60-in. cyclotron is a fixed 10.8 Mev/nucleon accelerator. To increase machine flexibility, it was desired to obtain variable energy projectiles 25 to 40 ft from the accelerator without severely reducing particle number and beam definition. Sacrificing energy resolution, a focused variable energy beam can be obtained by using the technique of a foil absorption system close coupled with strong focusing provided by quadrupole magnets. The system described can readily degrade a deuteron or α beam to about 2.5 Mev/nucleon with about 5% of the original particles focused a distance of 35 ft from the accelerator. (auth)

2262

THE PRETORIA CYCLOTRON. SECOND REPORT. J. J. Burgerjon and W. Weidemann (National Physical Research Lab., Pretoria). Nuclear Instr. & Methods 8, 261-71(1960) Sept. (In English)

Improvements to the cyclotron are discussed as well as the extraction and external focusing of the beam. The various components, in so far as they have been subject to alterations, as well as new components, are described. The properties of both the internal and external beams are discussed in separate chapters. Reference is made to the first report. (auth)

Plasma Physics and Thermonuclear Processes

2263 AD-236253

Kansas State Univ., Manhattan.

THE PROPERTIES AND USES OF AN ARC PLASMA JET GENERATOR (thesis). Richard Dean Turner. 1960. 69p.

Various devices which generate a jet of plasma in a temperature range of 10,000 to 35,000°F are being developed by organizations interested in research at high temperatures. Known properties and uses of the plasma jet generator are discussed. (W.D.M.)

2264 AFSWC-TR-59-64

Air Force Special Weapons Center, Kirtland AFB, N. Mex.

SELF-CONFINEMENT OF PLASMAS. L. N. Zadoff, M. Bernstein, and J. Reinheimer. Oct. 9, 1959. 24p. Project No. 7811. Contract AF29(601)-1218. (MSD-206-955).

An isolated plasmoid must expand. Expansion is demonstrated by extending the integrations involved in the Chandrasekhar-Fermi virial theorem over all space. It is established that the general conclusion of the

Chandrasekhar-Fermi virial theorem regarding the impossibility of self-confinement in a bounded, three-dimensional region of space does not contradict the description of the pinch effect. In the linear pinch, the radius of a plasma cylinder is bounded, but not its length. It is also demonstrated that if the particle description of plasma behavior is substituted for the continuous-fluid description, it can still be shown that self-confinement is possible only in less than three dimensions. It is concluded that there is no such physical phenomenon as self-confinement of a plasma to be bounded, three-dimensional region of space. (auth)

2265 CF-60-9-112

Oak Ridge National Lab., Tenn.

ION ENERGY DISTRIBUTION, ENERGY DEGRADATION, AND EXPONENTIATION CRITERIA IN A PLASMA FORMED BY BEAM TRAPPING AND CHARGE TRANSFER. D. J. Rose. Sept. 30, 1960. 23p. OTS.

An approximation is derived for the time constant which characterizes the rate of energy loss of fast ions moving through a plasma. Using particle and energy-balance equations a simple approximate criterion is derived for the estimation of the importance of energy degradation during plasma buildup in a DCX type machine. The steady-state ion energy distribution is derived for a case in which energy losses are to electrons at a given temperature and particle losses are by charge exchange. The distribution function is used to compute loss rate, upper critical current, ionization rate, and other functions of interest. Quantitative application is made to DCX-2 under various conditions of operation of carbon and deuterium arcs. (auth)

2266 GA-1726

General Atomic Div., General Dynamics Corp., San Diego, Calif.

ENGINEERING APPLICATIONS OF MAGNETODYNAMICS GENERAL PLASMA THEORY. Norman Rostoker. Oct. 11, 1960. 11p. Project No. 30.

For presentation at the Engineering Inst. on Engineering Applications of Magnetodynamics, University of Wisconsin, Oct. 27-28, 1960.

The theoretical structure of plasma physics is briefly reviewed and the three stages of description of a plasma are illustrated. Plasma instabilities are discussed in some detail. (W.D.M.)

2267 NP-9177

Stichting voor Fundamenteel Onderzoek der Materie. Instituut voor Plasma-Physics, Jutphaas, Netherlands.

DESIGN OF MAGNETIC FIELD COILS FOR THERMONUCLEAR EXPERIMENTS. Rijnhuizen Report 60-01. C. M. Braams. May 1960. 17p.

The minimization of cost in designing and constructing an iron-free magnetic field coil with a power supply is discussed. Criteria for the design and construction of the most economic coil shape, conductor material, and current density are derived. (C.J.G.)

2268 NP-9257

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

THE USE OF LOW IMPEDANCE TRANSMISSION LINES IN PLASMA HEATING AND CONFINEMENT STUDIES. M. H. Dazey, V. Josephson, and R. F. Wuerker. Aug. 8, 1960. 32p. Contract AF04(647)-309. (STL/TR-60-0000-09255).

An 18 kv type "C" transmission line of 0.28 ohms characteristic impedance, 10 μsec pulse length, and 0.5 μsec rise time was connected through a triggered air gap to a one turn copper solenoid 10 cm in diameter by 15 cm in length surrounding a cylinder of low pressure D_2 gas. Experimental measurements of the transverse pinch heating and confinement phenomena were made via smear photographs and magnetic probes. The gas (25 to 500 μ Hg pressure) was pre-ionized 5 μsec prior to the application of the transverse field by a 250 kc/sec linear discharge of several thousand amperes. Application of the fast-rising constant-current transverse pinch field to the conducting plasma at 25 μ pressures yielded both radial implosion velocities (~10 cm/μsec) and sheath oscillatory frequencies (1 to 2 mc/sec) expected from theory. Diffusion of the external field into the interior of the diamagnetic plasma matches the rate of plasma loss through the ends of the confining region (e.g., at 25 μ, longitudinal streaming velocities as high as 20 cm/μsec were observed). The effect of the rate of rise of the transverse field on the magnetic piston velocity and sheath thickness was investigated by varying the number of transmission line sections. (auth)

2269 NP-9291

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

DYNAMIC STABILIZATION OF A PLASMA COLUMN. Erich S. Weibel. Aug. 15, 1960. 62p. (STL/TR-60-0000-GR-269).

A cylindrical plasma column is confined by a magnetic field whose z-component is constant while the φ-component oscillates sinusoidally. The skin depth is assumed to be negligible so that the boundary can be considered as sharp and the interior of the plasma as field free. The plasma itself is treated as an assembly of non-colliding particles which are specularly reflected at the plasma surface. The oscillating pressure of the applied field causes the plasma surface to execute a small periodic motion independent of φ and z. All other components of the displacement decay in time, thus the plasma is positively stable against all deformations. For magnetostatic confinement this treatment yields the usual instabilities; but in contrast to earlier work, the growth rates are bounded as the deformation wave length approaches zero. This appears to be in better agreement with experiment. (auth)

2270 NP-9293

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

SUPERFAST PINCH STUDIES. Lee O. Heflinger and Stanley L. Leonard. Aug. 1960. 64p. Contract AF04(647)-309. (STL/TR-60-0000-09226).

An apparatus designed to accelerate protons of a hydrogen plasma to energies of 1 kev or more by means of the radially converging magnetic piston of a longitudinal pinch was constructed. A capacitor charged to voltages of up to 300 kev is discharged through the plasma, producing currents of up to 75 ka. The ringing frequency is 18 mc, so that the rate of current rise is about 0.8×10^{13} amp/sec. Radially converging luminous fronts with maximum velocities in excess of 50 cm/μsec were observed and were interpreted as shock waves driven by a magnetic piston. Magnetic probe measurements and measurements of the electric field at the wall of the discharge tube showed that much of the magnetic flux introduced during the first half cycle was trapped in the hot plasma. The effects of varying such parameters as the total current, the initial pressure of the gas, the type of gas, and the frequency of the discharge were investigated. The experimental results are interpreted in terms of the classical Rosenbluth-Garwin theory of the pinch, which seems to correlate well with the observations. (auth)

2271 NP-9310

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

THE MAGNETIC INDUCTION PLASMA ENGINE. Milton U. Clauser. Aug. 19, 1960. 40p. (STL/TR-60-0000-00263)

Basic concepts needed to design magnetic induction plasma engines with a specific impulse of 10,000 sec are reviewed. This value is in the range of interest for space travel and allows comparison with the ion engine. An engine with a specific impulse of 3,000 sec is also considered. The use of different propellants in the MIP engine makes it possible to efficiently achieve different values of specific impulse. Design parameters along with calculated weights and efficiencies are given for deuterium and lithium engines. (W.D.M.)

2272 NP-9319

Space Technology Labs., Inc. Physical Research Lab., Los Angeles.

THE NEUTRON PRODUCING MECHANISM IN TRANSVERSE PINCHES. V. Josephson, M. H. Dazey, and R. F. Wuerker. Aug. 9, 1960. 14p. Contract AF04(647)-309. (STL/TR-60-0000-19258).

Experiments performed on a transverse pinch assembly showed that the presence of a longitudinal magnetic field inside a conducting plasma and in the reverse direction to that of the external pinching field results in the generation of the m = 0 (sausage) instability mechanism. It was found that this instability mechanism can generate high-electrical fields that will accelerate deuterons to energies sufficient for neutron production in deuterium plasmas. Subsequent to the blow-up of the instability, it was observed that the plasma-field configuration is such that the accelerated deuterons can continue to circulate in stable orbits until lost by neutron producing collisions or by diffusion out the ends of the geometry. (auth)

2273 NYO-7313(Rev.)(Pt.I)

Princeton Univ., N. J. Project Matterhorn.

A RESISTANCE ANALOGUE DEVICE FOR STUDYING AXIALLY SYMMETRIC MAGNETIC FIELDS. PART I. Kenneth E. Wakefield. Nov. 28, 1958. 19p. Contract AT(30-1)-1238. (PM-S-23)(Rev.)(Pt.I)). OTS.

An analog device for determining the stream lines of an axially symmetric magnetic field is described; it consists of a two-dimensional network of resistors. (C.J.G.)

2274 PIBAL-549

Brooklyn. Polytechnic Inst. Aerodynamics Lab.

ELECTRON DISTRIBUTION ACROSS A DISCONTINUITY OF ION DENSITY IN A PLASMA. Manlio Abele. Mar. 1960. 16p. Project No. 5561. Contract AF30(602)-2045. (RADC-TN-60-77; AD-235864).

The problem of the electron distribution in the vicinity of a discontinuity of ion density is discussed in the present report, assuming that a plane infinite surface separates a uniform plasma from a vacuum. The density of electrons in the vacuum is always very small compared to the ion density of the plasma. The results indicate that the electron density vanishes at large distances from the interface with a rate of decrease which is small compared to the rate of change of the electron density within the plasma. (auth)

2275 UCRL-9311

California. Univ., Berkeley. Lawrence Radiation Lab.

A SIMPLE ANALYSIS OF THE TUBULAR PINCH DISCHARGE. Wulf B. Kunkel. July 25, 1960. 15p. Contract W-7405-eng-48. OTS.

An analysis of the tubular pinch discharge as a circuit element based on the assumptions of cylindrical symmetry and small deviations from equilibrium is presented. External observables, such as voltage and currents, may be interpreted under these assumptions in terms of plasma thickness and plasma motion, and therefore may be used for temperature and pressure estimates. The analysis is applied to an example of actual oscilloscopically observed signals. (auth)

2276 USCEC-56-216

University of Southern California, Los Angeles. Engineering Center.

MOMENT EQUATIONS AND BOUNDARY CONDITIONS FOR MAGNETO-GAS DYNAMICS. Hsun-Tiao Yang. July 29, 1960. 58p. Contract AF18(603)-95. (AFOSR-TN-60-963).

Based on the work of Burgers and Kolodner, moment equations are obtained from the Boltzmann equation for a conducting gas in electric and magnetic fields. The moment equations consist of (1) the conservation equations of mass, momentum, and energy with arbitrary stress and heat flux and (2) the constitutive equations of stress and heat flux. By assuming the Grad distribution function and slight ionization, stress and heat-flux equations are derived which yield a single-fluid description of the gas mixture. The associated boundary conditions are obtained by taking the assumed distribution function and applying conservation laws near the wall. These moment equations and boundary conditions together with Maxwell's electromagnetic equations and their boundary conditions form a determinate system to describe the dynamics of a rarefied conducting gas in electric and magnetic fields. This system includes, as limiting cases, both the Grad 13-moment equations for rarefied gases and the usual continuum magnetogasdynamic equations. (auth)

2277 USCEC-56-218

University of Southern California, Los Angeles. Engineering Center.

LOW-SPEED PLANE COUETTE FLOW OF A RAREFIED CONDUCTING GAS IN A UNIFORM TRANSVERSE MAGNETIC FIELD. Hsun-Tiao Yang. Aug. 1960. 30p. (AFOSR-TN-60-1002).

Previously developed moment equations and boundary conditions for magnetogasdynamics from the Boltzmann equation of the kinetic theory of gases are applied to low-speed plane Couette flow of a rarefied conducting gas in a uniform transverse magnetic field. The upper plate velocity is assumed to be small compared with the ambient speed of sound, and the temperature difference between the two plates is small compared with the ambient temperature. The tangential flow quantities such as velocity, shear stress, and tangential heat flux are solved separately from the normal quantities such as pressure, temperature (density), normal stresses, and normal heat flux. The tangential quantities are greatly influenced by the transverse magnetic field, whereas there is little or no effect of the magnetic field on the normal quantities. The explicit expressions for tangential as well as normal quantities are obtained. These results include those obtained for low-speed plane Couette flow in rarefied gasdynamics and in continuum magnetogasdynamics as limiting cases. The effect of the transverse magnetic field is to retard the flow, and the more rarefied the gas is, the more pronounced is the effect. As a result the velocity slip is decreased owing to the magnetic field. There is a heat flux in the flow direction despite absence of temperature gradient (The Ettingshausen effect). The skin friction at the lower plate is decreased owing to the magnetic field, but the total drag of skin friction plus magnetic drag is increased. It was

found that both the induced electric current and the induced magnetic field decrease owing to rarefaction. (auth)

2278 AEC-tr-4072

INSTABILITY OF THE INDUCTION (THETA) PINCH. I. F. Kvartskava, K. N. Kervalidze, and Yu. S. Gvaladze. Translated for Princeton Univ. from Zhur. Eksptl'. i Teoret. Fiz. 38, 1641-3(1960). 21p. OTS.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract No. 19901.

2279 AEC-tr-4181

Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut.

INVESTIGATION OF INTERACTION OF AN ELECTRON BEAM WITH A PLASMA. Translation of Issledovanie Vzaimodeistriya Electronnogo Puchka s Plasmoi. I. F. Kharchenko, Ya. B. Fainberg, R. M. Nikolaev, E. A. Kornilov, E. I. Lutsenko, and N. S. Pedenko. 1959. 19p. OTS.

A paper was previously abstracted and appears in NSA, Vol. 14, abstract No. 17490.

2280

INTERACTION OF A TEST PARTICLE WITH A PLASMA. PART I. DISTRIBUTION FUNCTION OF FIELD PARTICLES. A. Ron and G. Kalman (Israel Inst. of Tech., Haifa). Ann. Phys. (N. Y.) 11, 240-59(1960) Oct.

The distribution function of plasma particles is calculated in the case where a charged test particle travels through a plasma. Conditions for the steady-state solution and the neglect of the interaction between the plasma particles are investigated. These calculations may serve as a starting point to find the coefficients of dynamic processes in plasma. (auth)

2281

RADIO-FREQUENCY FORCED OSCILLATIONS IN NON-UNIFORM PLASMAS. R. B. R. -Shersby-Harvie (Services Electronics Research Lab., Baldock, Herts, Eng.). J. Electronics and Control (1), 8, 421-30(1960) June. (In English)

A wave equation and associated equations are derived for periodic forced oscillations in a collision-free plasma. This set of equations is rather complicated and small signal approximations are derived which are applicable to plasma confinement problems. One approximation is applied to the case of a fast E_0 travelling wave in plasma, and its behavior is shown to be markedly different from the well-known case of an E_0 wave at cut-off. Some difficulties with small signal theories are indicated, and the need for further clarification is pointed out. (auth)

2282

PLASMA OSCILLATIONS IN A MAGNETIC FIELD. Ikuo Kaji (Hokkaido Univ., Japan) and Masafumi Kito. J. Phys. Soc. Japan 15, 1851-61(1960) Oct. (In English)

In the presence of a uniform external magnetic field, the initial value problem for a longitudinal electron oscillation in a fully ionized plasma is treated in the range of the linear theory under the assumption that collisions are negligible and that the angle θ between wave vector and magnetic field is not equal to $\pi/2$, and $\mathrm{Re}(s) \neq 0$ on the complex s-plane. It is shown that if the indicial condition is determined the solution of initial value problem varies as $\exp(i\mathbf{k}\cdot\mathbf{r} + \alpha t)$, where α is a complex valued frequency, then for $\mathrm{Re}(\alpha) < 0$ (damped wave) there appears an indeterminancy in the dispersion equation of the potential, and for $\mathrm{Re}(\alpha) > 0$ (amplified wave) each dispersion equation of the proper plasma oscillations, the perturbed velocity distribution function, and the potential are coincident. As a typical example, the case in which the equilibrium distribution is Maxwellian is discussed. (auth)

2283

RADIATION OF PLASMA OSCILLATION. Shoji Kojima and Shigeo Hagiwara (Tokyo Univ. of Education). J. Phys. Soc. Japan 15, 1904(1960) Oct. (In English)

Plasma radiation of the same frequency as the electron plasma oscillations was studied in the microwave region using a mercury-filled hot cathode tube and detecting the radiation with an electromagnetic horn and a superheterodyne receiver of intermediate frequency 70 Mc (band width 2 Mc). Experiments on microwave reflection were also carried out using a klystron signal source in order to determine the electron concentration in the plasma. From the radiation and reflection data vs. discharge current for a frequency of 9600 Mc and a pressure of 3×10^{-3} mm mercury, the radiation shows a resonance at the current where reflection reaches saturation and thus appears to originate from plasma oscillations. When the tube pressure was increased to 10^{-2} mm mercury, the resonance decreased to below the noise level. The observations support the conclusion that the plasma oscillations are strongly excited in front of the cathode and that its transformation into radiation takes place markedly in inhomogeneous plasma. (D.L.C.)

2284

RADIO-FREQUENCY DISCHARGES IN MAGNETIC FIELDS. F. Bisi and B. De Michelis (Istituto di Fisica del Politecnico, Milan). Nuovo cimento (10) 17, 343-54(1960) Aug. 1. (In English)

Measurements on r-f discharges in argon were performed by using a magnetic field normal to the r-f electric field. The power absorbed by the discharge was determined as a function of the pressure inside the chamber and the magnetic fields. Different curves were obtained by increasing or decreasing the pressure. Different geometrical arrangements were used. The qualitative behavior of the discharge was interpreted by using an average electron picture. (auth)

2285

INSTABILITY MECHANISMS IN TRANSVERSE PINCHES. Vernal Josephson (Space Tech. Labs., Los Angeles). Phys. Rev. Letters 5, 416-17(1960) Nov. 1.

The mechanism is described as the application of a fast-rising B_z pinching field around a plasma cloud containing an internal antiparallel B_z pinching field which causes the internal magnetic field lines to form long closed loops threading a plasma cylinder. The cylinder deforms rapidly to a doughnut with surface currents flowing peripherally to maintain the closed magnetic field configuration. The configuration is identical to the Perhapsatron type pinch and is subject to the same $M = 0$ (sausage) instability that has produced neutrons in both linear and toroidal pinches. Internal and external (fringing) magnetic probes, Kerr cell photographs, and smear camera photographs have furnished data which allow a logical explanation of the mechanism and its importance in neutron production. (B.O.G.)

2286

VIRIAL EXPANSION FORMULAE FOR THE MICROFIELD AND MICROPOTENTIAL DISTRIBUTION FUNCTIONS AND THEIR APPLICATION TO A HIGH TEMPERATURE PLASMA. Tohru Morita (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto) 23, 1211-13(1960) June. (In English)

Virial expansion formulas are developed for the microfield and micropotential distribution functions on the basis of the similarity of their Fourier transforms to those of

chemical potential and should be useful for low-density gases. The example of a plasma is considered; the result calculated in the ring approximation is found to be identical with the Holtsmark distribution function. The situation is similar for the distribution functions of other micro quantities. (D.L.C.)

2287

IMPROVEMENTS RELATING TO THE GENERATION OF POWER BY NUCLEAR REACTIONS. Arthur Watson Aikin (to Metropolitan-Vickers Electrical Co., Ltd.). British Patent 851,355. Oct. 12, 1960.

A thermonuclear reactor is described which comprises an accelerating chamber for deuterons and tritons, means for accelerating the particles to initiate fusion reactions, a walling of lithium, and ducting for a coolant. In operation, Li^6, bombarded with neutrons from fusion reactions, produces tritons to enhance reactor efficiency. The lithium may be in the form of a mixture of lithium tritide and lithium deuteride. (D.L.C.)

Shielding

2288 NP-9354

Convair, Fort Worth, Tex.

REACTOR SHIELD HEATING CALCULATIONS FOR GAMMA RAYS. R. L. French. June 1958. 28p. (FZM-1076).

The theory of γ heat generation is discussed, and a new method for calculating heat-generation rates is presented. The method employs differential-energy spectra in an iteration formula which gives the modified γ spectrum from an elemental volume of the reactor core after penetration of successive layers of material. An integration over the core volume gives the total γ spectrum for the point at which the heat-generation rate is to be determined. Application of energy-absorption coefficients and an integration of the spectrum over energy yield the heat-generation rate. Results obtained with the method agree within 30% with heat-generation rates measured at the Bulk Shielding Reactor. (auth)

Theoretical Physics

2289 NP-9311

Maryland. Univ., College Park and Naples. Universita. Istituto di Fisica Teorica.

LIE EQUATIONS FOR A LEE MODEL. E. R. Caianiello and S. Okubo. July 1960. 21p. Contracts AF49(638)-24, Physics Dept. Technical Report No. 185 and DA-91-591-EUC-1096, Technical Report No. 12. (AFOSR-TN-60-898).

The renormalization in configuration space of a slight generalization of the Lee model is discussed as an example of general procedures, which seem to be applicable also to more general cases than the present one. The replacement of ordinary with finite-part integrals removes consistently all ultraviolet infinities and permits writing the Lie equations of the renormalization group, the solution of which yields the familiar relations between unrenormalized and renormalized parameters. (auth)

2290 AEC-tr-4205

Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics.

ON THE THEORY OF PHASE TRANSITIONS. (K Teorii Fazovogo Perekhoda). N. N. Bogolyubov (Bogoliubov), D. N. Zubarev, and Yu. (Iu.) A. Tserkovnikov. Translated by Lydia Venters (Argonne National Lab.) from report JINR-P-110, 1957. 10p. JCL.

Also published in Doklady Akad. Nauk S.S.S.R. 117, 788-91(1957).

A mathematical model was developed, based on the Hamiltonian of Bardeen, from which asymptotically accurate expressions can be derived for phase transitions in superconductivity. (C.J.G.)

2291

TRIPOLE GHOSTS IN FIELD THEORY. K. L. Nagy (Universita, Rome). Nuovo cimento (10) 17, 384-94(1960) Aug. 1. (In English)

An appropriate modification of the Lee model is discussed. For a definite set of parameters, the dipole ghost state and also a tripole ghost are found by using the Källén-Lehmann method. Contributions of tripole ghost states, supposed to exist in a relativistic quantum field theory, are calculated. (auth)

2292

HIGH-ENERGY BEHAVIOR OF CROSS SECTIONS IN QUANTUM ELECTRODYNAMICS. K. E. Eriksson and A. Peterman (European Organization for Nuclear Research, Geneva). Phys. Rev. Letters 5, 444-5(1960) Nov. 1.

If the detection of a possible breakdown of quantum electrodynamics is desired at small distances by comparing high-energy scattering experiments with theoretical predictions available to some given order in α, the following question arises: what is the magnitude of the radiative corrections beyond that order? The problem, whether or not the effective expansion parameter is $(\alpha/\pi)\ln^2(q^2/m^2)$, was investigated, and it was concluded that this is not the case but that the series of radiative corrections to the scattering cross sections, in the center-of-mass system, is rather an expansion in terms of an effective parameter which is at most: $(\alpha/\pi)\ln_4(q^2/m^2)$. (B.O.G.)

REACTOR TECHNOLOGY

General and Miscellaneous

2293 AD-233761

North Carolina State Coll., Raleigh.

CONCENTRIC VOIDS IN SPHERICAL REACTORS AND CELLS (thesis). Harry Martin Mitchell. 1960. 82p.

Concentric voids in spherical-geometry reactors are examined for their effects on boundary conditions and critical fuel loading. Expressions relating fluxes and currents at the void interfaces are derived on the basis of diffusion theory. The two-group critical equation is developed for a two-region reactor with various void locations. A numerical example is presented for comparison of this theory with a calculation based on continuity of perimeter flux and current across the void. The difference in critical loading and flux behavior is significant. The boundary conditions are applied to a fuel cell with an air gap. Explicit forms are developed for the flux distributions and thermal utilization of the cell. (auth)

2294 AERE-M-723

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

MEASUREMENTS OF $U^{238}:U^{235}$ FISSION RATIOS IN GRAPHITE MODERATED SYSTEMS. M. D. Carter and A. J. Perks. Aug. 1960. 8p. BIS.

Measurements of $U^{238}:U^{235}$ fission ratios were made in a

number of isolated single rods of natural uranium, in two natural uranium lattices, and in one lattice of slightly enriched uranium rods. The results obtained are presented. The significance of a measurement of fission ratio made with "clean" foils (i.e., free from oxide surface layers) is discussed. (auth)

2295 AFSWC-TN-60-17

Air Force Special Weapons Center, Kirtland AFB, N. Mex.

REACTOR FUSING—SOME TECHNICAL POSSIBILITIES. Thomas G. Stockham, Jr. Aug. 1960. 14p. Project No. 3785.

The field of reactor fusing is discussed. Fuses are divided into two classes; advanced scram types and atomic scale types. The former are presently receiving development effort, and the latter offer possibilities for higher reliability. The discussion concentrates upon the atomic scale fuse concept and the study of the dynamics of a particular example thereof. A new approach to the reactor fusing problem is presented, and the technical areas which require investigation before further implementation of the concept can be realized are pointed out. (auth)

2296 ANL-6215

Argonne National Lab., Ill.

REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT [FOR] AUGUST 1960. Sept. 16, 1960. 59p. Contract W-31-109-eng-38. OTS.

General research and development on water- and sodium-cooled reactors are reported along with specific developments on EBWR, BORAX-V, EBR-I, and EBR-II. Thermal and fast reactor safety studies are summarized in terms of fuel-coolant chemical reactions, kinetics of oxidation, ignition of reactor metals, and TREAT development. Developments in reactor fuels and materials, reactor components, separations, and advanced reactors are discussed in some detail. (W.D.M.)

2297 ANL-6234

Argonne National Lab., Ill.

REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT [FOR] SEPTEMBER 1960. Oct. 14, 1960. 76p. Contract W-31-109-eng-38. OTS.

2298 GAMD-1224

General Atomic Div., General Dynamics Corp., San Diego, Calif.

A FORTRAN PROGRAM FOR STUDYING THE CORE COLLING CAPACITY OF A HELIUM-AIR MIXTURE. R. C. Kaestner and R. J. Mulvihill. Feb. 1, 1960. 59p. Project No. 32. Contract AT(04-3)-314. OTS.

A FORTRAN II program is described which, for a given set of core conditions, calculates the maximum inlet gas temperature for a helium–air mixture subject to the condition that the heat removed be greater than or equal to the heat generated by graphite-oxidation and fission product decay at every point along the active length of the fuel element surface. The equations describing the process are given, and the FORTRAN program is included. Results are presented for various air–helium mixtures for a total pressure in the containment vessel of 22.5 psia. It was concluded that, on the basis of the model used, the core can be cooled by a mixture in which the mole fraction of helium is greater than 0.9 and flow is in the turbulent range. (auth)

2299 KAPL-2090

Knolls Atomic Power Lab., Schenectady, N. Y.

DIGITAL COMPUTATION OF SPACE-TIME VARIATION OF NEUTRON FLUXES. E. L. Wachspress. Oct. 1, 1960. 38p. Contract W-31-109-eng-52. OTS.

Theoretical aspects of program Coupled Lines and Groups (CLAG) for computing the space-time variation of neutron fluxes with a three-dimensional nodal representation of the reactor are presented. A multichannel synthesis method is presented which enables neutron diffusion computations with simultaneous group inversion. This model permits dynamics analysis with space and time variation not separated. (C.J.G.)

2300 TID-6643

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

PROGRAM SHAG—A MONOENERGETIC MULTIREGION SLAB CELL CORRECTION CALCULATION (GE-ANPD PROGRAM NO. 518). F. D. Wenstrup. June 8, 1960. 89p. Contracts AF33(600)-38062 and AT(11-1)-171. (XDC-60-8-22). OTS.

An IBM 704 program is described which computes a one-energy neutron-cell correction in a multiregion slab cell using the P_7 and double-P_3 spherical-harmonics approximations to the neutron-transport equation. Input to the program includes regional data describing the geometrical configuration of the cell and composition data giving the material concentrations in each region. The program provides convenience and added accuracy by obtaining all material cross sections directly from the ANP Nuclear Data Tape. Output from the program includes the scalar-flux distribution, normalized to the total source, at each lattice point in the cell. Regional average scalar fluxes are computed, and cell corrections or flux depression factors are obtained for each region of the cell. The program was written using the FORTRAN II system of automatic coding for the IBM-704. (auth)

2301 TID-6647

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

A PROGRAM FOR THE PREPARATION OF A NUCLEAR DATA TAPE WITH FINE ENERGY DETAIL (PROGRAM FINDT, ANP NO. 554). J. R. Cooper and W. B. Henderson. May 13, 1960. 81p. Contracts AF33(600)-38062 and AT(11-1)-171. (XDC-60-8-69). OTS.

A program is described to prepare a nuclear data tape for the IBM-704 from available experimental data. The format is designed specifically for use with program C-Fine. The program is designed to generate cross sections in resonance regions using the Breit-Wigner single-level equations and to perform simple manipulations of the cross sections. The program also has the capability of generating fission source spectra from parameters. A minimum amount of input is required. Materials or sources may be added to or deleted from the tape and the existing records may be expanded to more levels. (auth)

2302

DESIGN OF REINFORCED CYLINDER FOR NUCLEAR REACTOR PRESSURE VESSEL. R. W. Lakin and S. S. Gill (Nuclear Power Group, Knutsford, Ches., Eng.). Engineer 210, 495-9(1960) Sept. 23.

On the assumption that nondestructive testing places a limitation on plate thickness, the design of a reinforced cylinder for a nuclear-reactor pressure vessel is discussed, with the object of allowing for increased pressure and greater heat production to be obtained from a given size of reactor without a proportionate increase in capital cost. The reinforcement consists of a number of layers of comparatively thin plate fitted around the main cylindrical shell, the joints being welded. Experimental work was done with the help of two $\frac{1}{10}$ scale models. It is concluded that the cylindrical part of the pressure vessel can be re-

inforced by thin laminar strips to make it suitable for working at the same pressure as that for the hemispherical ends. (auth)

2303

STUDY ON THE TRANSFER FUNCTIONS OF SPATIAL KINETICS IN THE NUCLEAR REACTOR. Atsushi Takeda (Japan Atomic Power Co., Tokyo). J. Atomic Energy Soc. Japan 2, 523-30(1960) Sept. (In Japanese)

In the spatial kinetic theory of the reactor, the modal method has been developed as the leading technique because of its simplicity, but this method of spatial kinetics is not always usable for control engineers who design the reactor control system because the modal method sometimes fails to show the reactor transfer function as clearly as the lumped reactor kinetic theory does. The modal method is therefore translated into transfer functional words in order to get a much more understandable presentation for control engineers. These words are to define the modal transfer function of zero power reactors in the same formula as the lumped theory and to introduce the interactive transfer function among the various modes. In the nonhomogeneous reactor, the modal transfer function is shown to be resolvable into the sum of simple delayed transfer functions, each of which corresponds to its proper sub-mode that could be equivalent to the original mode of the homogeneous reactor if such sub-mode responses are summed. The interactive transfer function can be eliminated by introducing such sub-mode groups into the nonhomogeneous reactor. (auth)

2304

NUCLEAR ACCIDENT SURVEY. J. Spencer Burkett. Nuclear Power 5, No. 54, 77-80(1960) Oct.

An extensive survey of reported serious radiation accidents is presented together with tables showing the casualty list of USAEC (1943 to 1958), possible power-reactor accidents classified according to reactor type, and actual accidents (both reactors and critical assemblies) over the world. The accidents discussed in detail are: (1) Canada. 30-Mw NRX reactor (Dec. 1952, contamination of coolant) and 200-Mw NRX reactor (May 1958, reactor contamination). (2) France. EL-2 and EL-3 D_2O research reactors (minor and routine accidents). (3) Yugoslavia. Vinca accident (Oct. 1958, irradiation of six persons, with one death). (4) United Kingdom. Windscale (Oct. 1957). Power excursions, processing-plant accidents, and noncritical accidents are also treated, and it is concluded that correct training in handling radioactive sources and anticipation of accidents through plans for early warning, evacuation, health physics, and decontamination are necessary. (D.L.C.)

2305

THE THERMAL SIMULATION OF FLUX DISTRIBUTION. R. Berenbaum, G. K. Caulton, and D. S. Greenaway (Atomic Power Constructions Ltd., [London]). Nuclear Power 5, No. 54, 92-6(1960) Oct.

Neutron flux distributions in thermal reactors as calculated by one-group theory can be approximated or simulated by the temperature distribution in a cooling solid, and equations for this analogy are given. Problems presented by boundary conditions and control-rod simulations can be solved by maintaining zero temperature at the model boundary, with tubes of low thermal conductivity in holes in the model to simulate control rods, and running coolant into the tubes to keep them at zero temperature. A cylindrical model made from investment casting was mixed with 10% aluminum powder, and 100 thermocouples were embedded at various positions. The coolant is water at 0°C. Three cases were studied: (1) bare cylinder, (2) cylinder with single central control rod, and (3) cylinder with 17 rods. The results in cases 1 and 2 were compared with theoretical flux distributions and bucklings for these cases, and case 3 is an example of the problems which the model can solve. Agreement in the comparisons was good, and the significance of the 17-rod case is discussed. The problems involved in accurate simulation of reactors and various ways of doing this are discussed. This modeling method can be useful in studying flattened reactors. (D.L.C.)

2306

THE DISTRIBUTION OF THERMAL NEUTRONS IN SPACE AND ENERGY IN REACTOR LATTICES. PART I. THEORY. Henry C. Honeck (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng. 8, 193-202(1960) Sept.

A method is developed for computing thermal neutron distributions in reactor lattices as functions of energy and a single spatial coordinate. The integral form of the transport equation is used and it is assumed that the scattering process is isotropic in the laboratory system. The energy exchange kernels are based on the free gas model of Brown and St. John. The resulting equations are solved by numerical techniques using the IBM 704. The iterative calculations are greatly accelerated by enforcing neutron conservation at each iteration. (auth)

2307

THE DISTRIBUTION OF THERMAL NEUTRONS IN SPACE AND ENERGY IN REACTOR LATTICES. PART II. COMPARISON OF THEORY AND EXPERIMENT. Henry C. Honeck and Irving Kaplan (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng. 8, 203-9(1960) Sept.

The results obtained in Part I are compared with experimental intracel foil activation measurements. The computed neutron density distributions in D_2O and graphite moderated lattices are in good agreement with the measured distributions. A systematic discrepancy between computed and measured neutron density distributions in water lattices is observed. This discrepancy is probably caused by the inadequacy of the gas model to describe slow neutron scattering from water. (auth)

2308

CRITICALITY CALCULATIONS OF BeO-MODERATED ENRICHED URANIUM SYSTEMS. Richard E. Lingenfelter (Univ. of California, Livermore). Nuclear Sci. and Eng. 8, 226-32(1960) Sept.

Criticality calculations were performed on a series of unreflected BeO–U assemblies made at the Lawrence Radiation Laboratory. The calculations were done with the one-dimensional, multigroup diffusion code ZOOM. In addition to determining the general reliability of the code input constants, studies were made of U-foil self-shielding corrections and the Be(n,2n) reaction. (auth)

2309

THE DYNAMICS OF A XENON-CONTROLLED REACTOR. J. Chernick (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 8, 233-43(1960) Sept.

The space-independent dynamics of a reactor controlled by xenon poisoning is investigated. For reactor periods comparable to the delay in xenon production, the reactor is stable. For shorter periods, the reactor is unstable in the neighborhood of equilibrium unless the prompt xenon yield is a large fraction of the total xenon yield. The reactor power then goes into a stable oscillation. With increase in reactivity, the oscillations are of relaxation type, having the character of a sequence of widely separated power pulses controlled by xenon poisoning. The intensity of the power pulse generally becomes excessive when the reactivity approaches the total controlled by prompt xenon. Xenon burnup is of minor importance over the region controlled by the prompt xenon yield, although it leads to flux

divergence at sufficiently short reactor periods. Analytical methods are developed for treating the dynamics of the system, and the prime importance of nonlinear effects is established. The need for data on the independent yield of both Xe^{135} and its 15 min isomer in fission of major reactor fuels is pointed out. (auth)

2310

EFFECT OF DELAYED NEUTRONS ON NONLINEAR REACTOR STABILITY. Elias P. Gyftopoulos and Jacques Devooght (Massachusetts Inst. of Tech., Cambridge). Nuclear Sci. and Eng. 8, 244-50(1960) Sept.

The effect of delayed neutron precursors on the stability of nuclear reactors described by nonlinear equations is investigated. It is shown by means of Liapunov's second method that a sufficient condition of stability is that the reactor be stable without delayed neutron precursors. An illustrative example is included. (auth)

2311

ON THE APPLICABILITY OF THE TRANSPORT APPROXIMATION TO THE CALCULATION OF REACTIVITY. G. Rakavy (Hebrew Univ., Jerusalem). Nuclear Sci. and Eng. 8, 251-3(1960) Sept.

The validity of the transport approximation is checked for systems which cannot be treated by the diffusion approximation and deviations of the transport approximation from exact calculations are evaluated by means of a perturbation formula. It is concluded that even for critical systems of dimensions of the order of the transport mean free path the transport approximation yields good results. (auth)

2312

CONTROL ROD THEORY FOR ASYMMETRICAL ARRAYS AND REFLECTED CORES. Raymond L. Murray, William R. Price, and Samuel H. Birken (North Carolina State Coll., Raleigh). Nuclear Sci. and Eng. 8, 254-9(1960) Sept.

Criticality conditions suitable for hand calculations are derived for reactor control rod configurations of practical interest. Two-group diffusion theory is applied to (a) arrays of several control rods of different materials, sizes, shapes, radial, and angular location; (b) reflected cores containing a symmetric ring of similar rods, with or without an axial rod. The reduction to elementary cases is demonstrated. (auth)

2313

THERMAL NEUTRON FLUX DISTRIBUTIONS IN METAL-HYDROGENOUS SHIELDS. D. C. Anderson and K. Shure (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng. 8, 260-9(1960) Sept.

A calculational technique is presented for predicting thermal neutron fluxes in the primary shields of reactor systems which eliminates reliance on mock-up experimental data. A multigroup P_1 approach is employed with the spatial dependence of the neutron attenuation adjusted through use of a point source attenuation kernel for a homogeneous hydrogenous medium. Comparison of calculation with experiment is presented. (auth)

2314

SPATIAL DISTRIBUTION OF RESONANCE ABSORPTION IN FUEL ELEMENTS. Manfred Wagner (Internationale Atomreaktorbau G.m.b.H., Bensberg, Ger.). Nuclear Sci. and Eng. 8, 278-81(1960) Sept.

A generalizable analytic approach is applied to the problem of resonance absorption spatial distribution in fuel elements for the particular case of a cylindrical lump of radius R immersed in moderator, scattering in the lump and Doppler broadening of resonances being neglected. The result is an expression of the resonance absorption at a distance r from the axis, $A(r) = (A'/\sqrt{\Sigma_0 R})f(r/R)$, where $f(r/R)$ is a universal function. This equation is generalized for slab and sphere geometries, and curves are given for the spatial distribution of these geometries. The results are compared with the experimental results of Hellstrand for irradiated rods of varying diameter and with the Monte Carlo calculations of Morton; the agreement is good. (D.L.C.)

2315

DYNAMIC PROGRAMMING AND NUCLEAR REACTOR SYSTEMS DESIGN. Nicholas Kallay (Atomics International, Canoga Park, Calif.). Nuclear Sci. and Eng. 8, 315-25(1960) Oct.

Applications of dynamic programming techniques are suggested for nuclear reactor optimization problems. Four problems are considered, together with a short discussion of their relative significance to the field, and a possible functional equation approach to the solution of each is indicated. (auth)

2316

SOME ASPECTS OF FLUID FUEL REACTOR DEVELOPMENT. Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng. 8, 346-60(1960) Oct.

Fluid fuel reactor development is reviewed and the advantages and disadvantages of this type of reactor are given. The technology of the Aqueous Homogeneous Reactor, the Aqueous Homogeneous Reactor Experiments, Molten Salt Reactors, and the Aircraft Reactor Experiment are discussed. (M.C.G.)

2317

THE DANCOFF EFFECT IN H_2O-D_2O MODERATED LATTICES. W. G. Pettus (Babcock and Wilcox Co., Lynchburg, Va.). Nuclear Sci. and Eng. 8, 361-2(1960) Oct.

An investigation was made of the validity of Bell's Dancoff factor for H_2O-D_2O moderated lattices defined by $\gamma = [1 + s/4\Sigma m\ Vm]^{-1}$ where s and $\Sigma m\ Vm$ are the pin surface and scattering cross sections for a unit cell. For a given lattice geometry this equation gives a linear relation between the reciprocal of the infinite lattice Dancoff factor and the moderator mean free path. Results from tests on 9 and 5 pin square lattices inside a cadmium thimble at the center of the Lynchburg Pool Reactor confirmed the practical utility of Bells' approximation. (M.C.G.)

2318

THE EFFICIENCY OF THE SAFETY RODS OF THERMAL REACTORS BY THE TWO-GROUP THEORY. Reimar Fröhlich (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H., Karlsruhe, Ger.). Nukleonik 2, 192-8(1960) Sept. (In German)

In a cylindrical reactor an arbitrary number of safety rods were completely inserted parallel to the axis. For the determination of the reactivity change caused, eigenvalue equations were derived for possible rod configurations with the help of the two-group theory. Special value is therefore placed on the mathematically satisfactory consideration of the boundary conditions at the surface of the safety rod. Using the Karlsruhe research reactor FR-2 as an example, the eigenvalue equations for air-filled, H_2O-filled, and D_2O-filled cadmium rods were evaluated as a function of the uniform rod radius. The numerical results were compared with corresponding results obtained within the one-group theory. (tr-auth)

2319

ELEMENTARY INTRODUCTION TO THE STUDY OF THE TIME-DEPENDENT LAPLACIAN. Ahmed Yüksel Özemre

(Teorik Fizik Enstitüsü, Istanbul). Nuleonik 2, 213-14 (1960) Sept. (In French)

The time dependence of the Laplacian of a multiplying medium is studied in connection with that of macroscopic fission and absorption cross sections and with the contribution of delayed neutrons. In order to compensate the reactivity variation which results and to assign to the Laplacian its initial value, the idea of "control function" is introduced, and the relation which it must satisfy is established. (tr-auth)

2320

APPLIED REACTOR THEORY IN THE INSTITUTE OF NUCLEAR RESEARCH. Roman Żelazny (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 439-59(1960). (In English)

A summary of the work of the Reactor Theory Group for 1958 to 1960 is given. Included are characteristics of reactor types and of the calculation methods applied to reactor design, reactor physical experiment interpretation, and neutron transport and thermalization theory problems. (auth)

2321

IMPROVEMENTS IN NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). British Patent 843,681. Aug. 10, 1960.

A graphite-moderated gas-cooled reactor can be designed with coolant-directing means in such a way that the coolant flow tends to maintain all the fuel-element sheaths at approximately the same temperature. Several configurations of such a reactor are presented; in three of them, (1) baffles are inserted around the core in the inlet and outlet chambers, the outer baffle having a central opening in the form of a convergent nozzle, (2) the inlet and outlet branches are in one end of the pressure vessel, the flow progressing from the core axis outward, and (3) the inlet and outlet branches are in one side of the pressure vessel, the flow being arranged to move from the core axis outward. (D.L.C.)

Power Reactors

2322 ANL-6178

Argonne National Lab., Ill.

COST STUDY OF A 100-Mw(e) DIRECT-CYCLE BOILING WATER REACTOR PLANT. C. F. Bullinger and J. M. Harrer. July 1960. 98p. Contract W-31-109-eng-38. OTS.

A technical and economic evaluation is presented of a direct-cycle light-water boiling reactor designed for natural circulation and internal steam-water separation. The reference 100-Mw(e) reactor power plant design evolved from the study should have the best chance (compared to similar plants) of approaching the 8 to 9 mill/kwh total power-cost level. (W.D.M.)

2323 ANL-6202

Argonne National Lab., Ill.

REVIEW OF THE STATUS OF SUPERCRITICAL WATER REACTOR TECHNOLOGY. J. F. Marchaterre and M. Petrick. Aug. 1960. 37p. Contract W-31-109-eng-38. OTS.

Supercritical water-reactor design studies are reviewed. The status of supercritical water technology relative to heat transfer and fluid flow, water chemistry, internal deposition on heated surfaces, plant power cycles, and reactor construction materials is reviewed. The direct cycle was found to offer the highest probability for achieving economic power. (C.J.G.)

2324 APAE-Memo-268

Alco Products, Inc., Schenectady, N. Y.

THERMAL STRESS TESTING OF SM-2 FUEL ELEMENTS. Final Report for January 1, 1959 to July 1, 1960. J. A. Christenson and J. D. Kortheuer. Sept. 20, 1960. 31p. Contract AT(30-3)-326. OTS.

To determine the thermal stability of SM-2-welded plate type fuel elements, test specimens were subjected to temperature differences across plate width. Thermal deflections caused by the relatively cool side plates restraining the axial expansion of the fuel region were measured along the axial centerline of the test specimens. Region-averaged temperature differences varied from 0 to 116°F, or about 135% of expected reactor operating differentials. Test specimens, machined from standard full-sized fuel elements, consisted of a single fuel plate and its proportionate share of element side plates, and displayed an I-shaped cross section. Thermal deflections of 0.005 in. maximum were measured at the expected reactor operating conditions of 87°F region-averaged temperature differences. With initial (cold) deflections assumed within the SM-2 tolerance of ±0.008 in., test results indicated that the total operating deflections will be ±0.013 in. maximum. (auth)

2325 APAE-Memo-275

Alco Products, Inc., Schenectady, N. Y.

STRUCTURAL TESTING OF SM-2 FUEL ELEMENTS. F. G. Coleman, Jr., and R. J. Herbert. Sept. 29, 1960. 70p. Contract AT(30-3)-326. OTS.

Ability of the originally designed SM-2 stainless steel fuel elements to withstand static transverse pressure gradients of normal reactor operation was investigated. Fourteen simulated original SM-2 type fuel elements made by Tungsten inert gas (TIG) and electric resistance welding processes were subjected to pressure gradients to 6 psi and measured for deflection during stress and distortion after stress. Tests provided a basis for selecting a reference SM-2 fuel-element design and established a method of predicting maximum plate deflections under anticipated SM-2 operating conditions. Results showed that TIG welded elements, slightly more prone to deflection, are preferred for SM-2 application because they are less susceptible to weld failure and that fuel plate thickness is the most significant parameter in determining plate strength. It was also found that equalizing the length of the outer and inner plates significantly reduces maximum plate deflection and that effects of weld spacing and side plate thickness were not significant within the pressure range of the tests. (auth)

2326 BAW-1033

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

LIQUID METAL FUEL REACTOR EXPERIMENT. Quarterly Technical Report for May 1957–September 1957. 79p. Contract AT(30-1)-1940. OTS.

The uncertainty of ±5 in. for the reference-design critical diameter is expected to be reduced greatly as additional information on physical properties of actual reactor materials becomes available and as the results of the Liquid Metal Fuel Reactor (LMFRE) critical experiment and allied work are analyzed. For the reference design, the contribution of inelastic scattering in bismuth to the total k_{eff} was calculated to be about 2%. The positive xenon temperature coefficient of reactivity was recomputed, for the case of no xenon removal, and found to be in good agreement with previous calculations. The U^{235} addition necessary to override fission-product poisoning was checked by raising thermal cut-off energy from 0.07 to 0.2 ev, increasing the required U^{235} additions by only 10 ppm. The relaxation length of thermal neutrons for the concrete

surrounding the reactor was calculated to be approximately 8 cm. A number of inadequacies were noted in the generalized set of core transient equations reported in the last quarterly report. These equations were improved to permit a final steady-state solution, to improve treatment of the delayed neutron precursor concentration, and to introduce a radial temperature dependence in the graphite. Graphite vendors' comments on specifications and preliminary working drawings for core-end reflector assembly and side reflector indicate that (1) core OD and side-reflector ID tolerances should be relaxed slightly and (2) the design does not provide access for cleaning loose scale from core fuel passages. To overcome the latter, an alternate top reflector arrangement, which includes a quadrant type graphite tank and drilled block insert, was completed. The core Bi/C volume ratio was revised to 0.5 (on a cell basis) and top and bottom reflectors were redesigned to give a Bi/C volume ratio of 0.2 (av.) measured at the horizontal midplane. Detailed engineering work on the reactor vessel and associated internals was completed. Control-rod thermal calculations were initiated to determine the practicality of solid rods and required cooling rates. Recalculated fission-product poison buildup, assuming various amounts of U–Bi absorbed in graphite, indicated this effect to be unimportant in the LMFRE. The required initial U^{235} concentration for the reference design was estimated to be about 800 ppm by weight. Major preliminary design modifications affecting Systems Engineering are listed. Investigation of primary-system dump-time requirements indicated that a rapid dump is not required for nuclear reasons. A preliminary investigation indicated that overpressure in the reactor plant would be 7 psi following the maximum credible accident. A study to determine what data can be obtained from the ETR loop (No. 2) degasser and how this data can be used in the LMFRE degasser design was started. The maximum tolerable sodium concentration in the fuel is not now apparent. Problems which might arise from sodium leaks into the fuel were considered. Uranium oxidation from the fuel could introduce varying amounts of uranium to the core, seriously damaging the reactor. The nature of uranium oxides and nitrides which might form in the loop will be studied. The simplest method of adding uranium, zirconium, and magnesium to the LMFRE fuel stream will be direct solution of the metals in the fuel. Schemes for handling fission gases from ETR loop (No. 2) were studied. The number of cells for reactor and auxiliary equipment containment was reduced from 14 to 7. Any component removed from the cells can be safely stored in a 31-ft-deep storage pool adjacent to the cells. An 80-ton capacity overhead crane, operated from a windowed control room, will be located in the reactor canyon above the cells. Remote maintenance equipment will be mounted on a heavy cast-iron plug stored in the canyon floor above a maintenance hot cell. There will be a steel door in one end of the canyon (for component removal) and two steel doors leading into the master control room and hot change room. The office and laboratory area will be L-shaped and the basement area beneath will house the auxiliary systems not requiring heavy shielding. The building will be ventilated so the air flow is directed from the least radioactive areas to the most radioactive areas and then to the hot filter room. The anticipated total electrical load will be 3000 kw. (For subsequent period see BAW-1041.) (W.D.M.)

2327 BAW-1144-1

Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.

NUCLEAR MERCHANT SHIP REACTOR SHIELD DESIGN SUMMARY REPORT. W. R. Smith and M. A. Turner. Aug. 1, 1959. 132p. Contract AT(30-3)-274. OTS.

The calculated source strengths of the principle radiations are presented: neutron, primary, and secondary γ; core-fission product build-up and decay; coolant activation; and activation of materials. The primary shield tank design is developed in terms of neutron, primary, and secondary γ dose rate profiles along the radial center-line. The biological shield design is outlined in terms of reactor sources and coolant sources. The reactor sources are treated as surface sources having a cosine-squared angular distribution. After-shutdown shielding for maintenance of components and fuel-handling operations is calculated. Fission product decay and Co^{60} activity in stainless steel are the dominant sources. The accidental release of fission products to the containment is considered. There are four appendixes: Appendix A tabulates the nuclear properties of the core, thermal neutron capture cross sections of the core materials, and the values of miscellaneous parameters that define the system; Appendix B shows the methods of calculating the source strengths; Appendix C summarizes the methods of calculating radiation attenuations and dose rates; Appendix D describes the procedure for calculating fission and corrosion product radioactivities in the primary coolant. (auth)

2328 BAW-1171

Babcock and Wilcox Co. Atomic Energy Div., [Lynchburg, Va.].

THE LIQUID METAL THORIUM BREEDER REACTOR. Feb. 1960. Changed from OFFICIAL USE ONLY Oct. 18, 1960. 205p. Contract AT(30-1)-1940. OTS.

Results of a conceptual design study to evaluate the economic feasibility of a large Liquid Metal Fuel Reactor with a breeding ratio >1.00 and a doubling time <25 years are presented. Factors in favor of the graphite-moderated Liquid Metal Thorium Breeder Reactor are outlined in the study which includes reactor design, systems design, plant layout, economic analysis, chemical processing, technology status evaluation, and estimates of research and development requirements. (J.R.D).

2329 CF-60-9-8

Oak Ridge National Lab., Tenn.

EVALUATION OF EXPERIMENT OFF-GAS SYSTEM FOR THE EGCR-LITR CAPSULE EXPERIMENT. R. E. Adams and W. E. Browning. Sept. 2, 1960. 12p. OTS.

A proposed modification to the experiment off-gas system for the EGCR-LITR Capsule Experiment is evaluated by comparing the atmospheric-radiation doses to laboratory personnel that could result in the event of an experiment failure while utilizing the present off-gas system to those doses that would result if various modifications to the existing system were effected. The modifications considered include the addition of an iodine-vapor adsorber and a krypton-xenon adsorber. The addition of an iodine adsorber to the off-gas system, which presently includes an absolute filter, would reduce the atmospheric dose to the thyroid from 510 to 1.4 mr. The total-body dose is reduced from 2.2 to 1.3 mr. Based upon these calculated atmospheric radiation doses, the conclusion is reached that the addition of an activated-charcoal iodine-vapor adsorber will reduce the atmospheric hazard to an acceptable level. (auth)

2330 DP-510

Du Pont de Nemours (E. I.) & Co. Engineering Dept., Wilmington, Del.

HEAVY-WATER-MODERATED POWER REACTORS ENGINEERING AND ECONOMIC EVALUATIONS. VOLUME I.

SUMMARY REPORT. June 1960. 121p. Contract AT(07-2)-1. OTS.

Capital investments and the cost of power were estimated for 21 heavy-water-moderated, natural-uranium-fueled power-reactor plants, ranging in capacity from 100 to 460 Mw(e). Comparisons were made of hot- and cold-moderator reactors and of the relative merits of pressure-tube and pressure-vessel designs. Reactors cooled with liquid D_2O, boiling D_2O, D_2O steam, and helium were evaluated. A cold-moderator pressure-tube reactor cooled with boiling D_2O shows the most economic promise of the D_2O-moderated reactor systems studied to date. Reactors of this type have sufficient reactivity to permit satisfactory fuel exposures, but the development of additional technology is a prerequisite for optimum designs. At capacities of 300 and 400 Mw(e), the estimated power costs from the current designs of boiling-D_2O pressure-tube reactor plants are 11.3 and 9.8 mills/kwh, respectively. From liquid-D_2O-cooled concepts of comparable capacities the indicated power costs are 7 to 20% higher. With an active development program, a power cost of 8.0 to 8.5 mills/kwh may be attained in a 300 Mw(e) boiling-D_2O reactor plant within the next decade. (auth)

2331 DP-525

Du Pont de Nemours (E. I.) & Co., Wilmington, Del.

HEAVY WATER MODERATED POWER REACTORS. Progress Report [for] July 1960. R. R. Hood and L. Isakoff, comps. Oct. 1960. 31p. Contract AT(07-2)-1. OTS.

Fifty-six "driver" fuel tubes for the Heavy Water Components Test Reactor (HWCTR) were coextruded and are being evaluated. The first irradiation test of Zircaloy-clad swaged tubes of uranium oxide was started at Savannah River. The irradiation specimens are 2 ft long × 2.30 in. OD × 1.46 in. ID. Two failures occurred among 15 swaged oxide tubes with stainless-steel sheaths that were irradiated at Savannah River. Three tandem-extruded joints of stainless steel and Zircaloy are being irradiated at a temperature below 100°C and an axial tensile stress of 13,000 psi. Experimental data were obtained at 650 and 800 psig on the head loss for forced flow of boiling water. (For preceding period see DP-515.) (auth)

2332 GEAP-3347

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

FAST OXIDE BREEDER–STRESS CONSIDERATIONS IN FUEL ROD DESIGN. K. M. Horst. Mar. 28, 1960. 34p. Contract AT(04-3)-189. OTS.

Expressions were determined for calculating the optimum fuel-rod geometry which will contain the maximum fission-gas pressure. Consideration was given to stresses from both internal gas pressure and heat transfer through the cladding wall. The allowable gas pressure is shown to reach a maximum at a specific ratio of cladding diameter to wall thickness. Inconel-X, niobium-alloy, and type 347 stainless-steel claddings are discussed. (W.D.M.)

2333 GEAP-3516

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

FUEL CYCLE PROGRAM, A BOILING WATER REACTOR RESEARCH DEVELOPMENT PROGRAM. First Summary Report [for] March 1959–July 1960. W. H. Cook. 59p. Contract AT(04-3)-189. OTS.

The Fuel Cycle Development Program is a basic development program for boiling and other water technology. It covers the areas of oxide fuel fabrication, irradiation, and examination; the physics of water-moderated reactors; and boiling-water heat transfer and stability. Schedules for the fuel-cycle program were examined, and it was concluded that portions of the Task A program should be conducted during the period May to Dec. 1959 in order to keep costs of the work as low as possible and to allow initiation of the fuel-cycle program at the earliest possible date after the Vallecitos BWR was returned to service. The basis for the scheduling of the work is discussed, and a chronological summary describing the content of the work is given. Technical progress is outlined and details are summarized. Subsequent reports issued monthly and quarterly will summarize the progress of the program. (W.D.M.)

2334 MND-M-1816

Martin Co. Nuclear Div., Baltimore.

PM-1 NUCLEAR POWER PLANT PROGRAM 5TH QUARTERLY PROGRESS REPORT [FOR] MARCH 1, 1960 TO MAY 31, 1960. F. Hittman. July 5, 1960. 187p. Contract AT(30-1)-2345. OTS.

The objective of the contract is the design, development, fabrication, installation, and initial testing and operation of a prepackaged air-transportable pressurized-water reactor nuclear power plant, the PM-1. The specified output is 1 Mw(e) and 7 million Btu/hr of heat. The plant is to be in operation by March 1962. The principle efforts during the quarter were the completion of the final design submittals and specifications for plant components. Systems development work included structural testing of a full-scale test package, performance of a loading demonstration in a C-130A aircraft, and completion of testing of the air-steam condenser model. Reactor development work included: (1) Initiation of the flexible zero-power test (PMZ-1) experimental program; (2) Fabrication and delivery of a PM-1 type fuel element for irradiation in the SM-1 and initiation of a loop irradiation test at the WTR; (3) Continuation of reactor flow and heat-transfer tests; (4) Development work on rare-earth control rods; and (5) Testing and redesign of the prototype magnetic jack type control rod actuator. Core fabrication continued with the delivery of UO_2 ordered to date and the completion of the production runs of fuel elements for the zero-power test. (For preceding period see MND-M-1815.) (auth)

2335 NAA-SR-Memo-3291

Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.

LIQUID HYDROCARBON AS SRE CORE TANK PROTECTION DURING CORE EXCHANGE. F. W. Dodge and J. D. Chilton. Nov. 3, 1958. 13p. OTS.

An investigation was conducted to determine the feasibility of using liquid paraffinic hydrocarbons for personnel shielding during Sodium Reactor Experiment core changes. Purified kerosene was found to be usable, and further work is in progress to determine optimum evaporation temperatures, as well as the benefits to be gained by further purification of as-received hydrocarbons. (J.R.D.)

2336 RISÖ-17

Denmark. Atomenergikommissionen. Førsgsinstitut, Risö.

PROGRESS REPORT ON THE DOR DESIGN STUDIES. H. Abel-Larsen, F. List, P. Knudsen, B. Micheelsen, K. Singer, M. Tezschner, and P. L. Ölgaard. Aug. 1960. 71p.

A feasibility study of a D_2O-moderated, organic-cooled power reactor, called DOR, is being performed at Risö. The work carried out until May 1960 is described and the background of the study is outlined. An account is given of the work carried out in the different working groups engaged on the design study: the mechanical-design

group, the reactor-physics group, the heat-transfer group, the metallurgy group, the UO_2 group, and the chemistry group. A comparison is made with other design studies of the same reactor type performed elsewhere, and some of the possible improvements of the reactor type are discussed. (auth)

2337 SL-1800

Sargent and Lundy, Chicago.

RESULTS OF 1959 NUCLEAR POWER PLANT CONTAINMENT TESTS. Alf Kolflat. Mar. 30, 1960. 35p.

Containment shells surrounding reactors are designed so that all of the boiling water could flash into lower pressure steam without exceeding the pressure for which the containment shell is designed. Tests are described which demonstrated that the size of containment shells can be very materially reduced or that they can be designed for reduced pressure. When cold water was properly arranged in a 14-ft.-diameter by 32-ft-high cylindrical tank no pressure rise was observed. (W.D.M.)

2338 YAEC-186

Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh.

SEMI-ANNUAL PROGRESS REPORT FOR THE PERIOD JANUARY 1 TO JUNE 30, 1960. H. E. Walchli. Aug. 15, 1960. 25p. For Yankee Atomic Electric Co. Contract AT(30-3)-222, Subcontract No. 1. OTS.

A technical description of the research and development work accomplished and the progress made during the period from Jan. 1 to June 30, 1960, are given. An evaluation and the resulting conclusions of work performed are given for each project in which definitive progress was made. The principle progress consisted of (1) nuclear physics calculations required for plant start-up operations; (2) determination of effect of radiation on control-rod lifetime; (3) calculation of Yankee Core I lifetime including a study of fuel depletion and control-rod programming using a few-group two-dimensional computer program; (4) analysis of effect of fabrication tolerances on engineering hot-channel factors; (5) calculation of DNB ratio for limiting fuel clearance conditions; and (6) fabrication of a satisfactory prototype nickel-plated silver–indium–cadmium control rod. (See also YAEC-143.) (auth)

2339 CEA-tr-A-215

IMPORTANCE DU SYSTÈME DE REFROIDISSEMENT DANS LA RENTABILITÉ DES PILES ATOMIQUES. (Importance of the Cooling System on the Economy of Atomic Reactors). Andreas Setzwein. Translated into French from Atomwirtschaft 3, 6-10(1958). 25p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract No. 6853.

2340 NP-tr-485

THE CONTAINMENT VESSEL IN A NUCLEAR POWER STATION. Carlo E. Rossi. Translated by S. Pease (U.K.A.E.A. Atomic Energy Research Establishment) from p.243-70, Chap. VI, "Rassegna Internazionale Elettronica e Nucleare. Atti Del Congresso Scientifico, Giugno 1959. Sezione Nucleare. Volume I". A publication of Comitato Nazionale Ricerche Nucleari, Rome. 38p. (Handwritten MS. copy). JCL.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, Abstract No. 9656.

2341

BURNOUT IN LIQUID-COOLED POWER REACTORS. D. G. H. Latzko. Atoomenergie 2, 143-9(1960) Sept. (In Dutch)

After describing the "burnout" phenomenon on liquid-cooled heat-transfer surfaces at high heat fluxes, a survey is given of some published quantitative correlations for the burn-out heat flux in vertical channels. It is shown how the knowledge of such correlations is essential in assessing the potential of liquid-cooled power reactor designs. (auth)

2342

DRESDEN DESIGN PHILOSOPHY. V. D. Nixon (General Electric Co., San Jose, Calif.). Nuclear Eng. 5, 436-8 (1960) Oct.

The design parameters of the Dresden Core are described through a logical consideration of the heat-transfer and fluid-flow limitations initially established. These limitations concerned maximum fuel temperature, void or steam content in the core, and heat-transfer conditions resulting in burn-out. In addition, allowance was made for axial power distributions, radial power distributions, fuel burn-up, and local flux peaking owing to water gaps between channels and fuel-rod segments. Ways in which these factors affect design are discussed. (M.C.G.)

2343

DRESDEN SAFETY ASPECTS. V. D. Nixon (General Electric Co., San Jose, Calif.). Nuclear Eng. 5, 438-9(1960) Oct.

The principal objectives in the design of the Dresden safety system were to achieve high reliability for continuity operation and to produce a system shutdown on approaching unsafe conditions. The concept of a dual safety system evolved to meet these basic requirements is discussed. The automatic scram functions that the Dresden safety system provides are described. When both halves of the dual safety system are de-energized all the control rods are inserted to shut down the reactor within approximately 2 sec. (M.C.G.)

2344

DRESDEN FULL POWER OPERATION. Nuclear Eng. 5, 440-1(1960) Oct.

Power operation of Dresden began Apr. 15, 1960, and the initial stages were concluded on May 1, 1960. The working-up period began on June 21, and the full-rated power of 630 Mw was achieved at 8 p.m. on June 29. Safety-rod oscillation tests showed no evidence of approach to unstable conditions. Tests were also carried out involving by-pass valves, secondary steam valves, recirculating pumps, turbine trip, reactor isolation, dual-cycle performance, and recirculation loops. Radiation levels at full power indicated that the design figures were quite conservative. A test was also made of maximum primary steam production in order to assess system margins. (M.C.G.)

2345

REMOTE MILITARY POWER PLANTS. Fred Hittman (Martin Co., Baltimore). Nuclear Eng. 5, 442-4(1960) Oct.

The military requirements for portable nuclear power plants operating in remote locations dictate design and performance characteristics that are different and more stringent than those for central-station plants. Five of these major requirements are discussed: portability, prepackaging, reliability, power-output requirements and economics, and special nuclear-safety and reliability requirements. Minimization of size and weight of the primary shielding and containment are additional problems. A brief description of the PM-1 primary loop is given to show how these problems were solved. (M.C.G.)

2346

N. S. SAVANNAH. Nuclear Eng. 5, 447-51(1960) Oct.

A description including drawings and pictures is given of the N.S. Savannah. The reactor core, control, primary

coolant circuit, pressure vessel, and heat exchangers are described. In addition the functions of several auxiliary circuits such as the systems for primary purification, hydrogen injection, buffer seal, component waste and drain, gaseous waste, sampling, primary relief, intermediate cooling, and emergency cooling are discussed. The Savannah's arrangements for shielding and containment and the electrical plant are also described. A general review is made of safety problems and precautions. The reactor mock-up which served as a check for designs during construction was also used in training the crew. (M.C.G.)

2347

SAVANNAH CONTROL ROD OPERATION. Nuclear Eng. 5, 452-4(1960) Oct.

The control-rod system for the N.S. Savannah reactor is divided into three subsystems. The first is a control-rod drive assembly with 21 electromechanical drive mechanisms and their associated switchgear and auxiliaries. The second is a hydraulic system to provide scram action and load balance during normal operation. The last is an electrical control and instrumentation system for switching, interlocking, monitoring, and servo-control of the other two subsystems. The components and functions of all three are described. (M.C.G.)

2348

SAVANNAH REFUELLING. J. D. McDaniels, Jr. (Babcock and Wilcox Co., Lynchburg, Va.). Nuclear Eng. 5, 455-9 (1960) Oct.

The basic refueling task in the N.S. Savannah consists of the replacement of 32 fuel elements, 21 control rods, and 2 neutron sources. The reactor-vessel head is secured by 48 studs of 5 in. diameter and sealed with 2 metal O-rings backed by a seal-welded membrane. To reduce turn-around time and provide a safe and reliable device to remove or tighten the stud nuts, a 600-ton-capacity stud tensioner was developed. After removal of the reactor-vessel head, the core hold-down internals are removed. A guide system is used so that elements may be withdrawn and replaced without concern for the ship's motion. After removal and replacement of the fuel elements, the reactor-vessel head is replaced. The control rods are reconnected to the drive actuators, the refueling tank seal removed, new instrumentation installed, and the head insulating cover replaced. (M.C.G.)

2349

ADVANCED SYSTEMS. A PERSONAL APPRAISAL. Alvin M. Weinberg (Oak Ridge National Lab., Tenn.). Nuclear Eng. 5, 463-5(1960) Oct.

Advanced civilian power reactors are reviewed. The most important trends noted in advanced reactor development are the trend toward unclad or ceramic-clad solid-fuel-element systems, the renewed interest in high-temperature liquid fuels, and the continued work on fast and slow neutron breeders. Reactors having these characteristics are discussed. (M.C.G.)

2350

YANKEE ATOMIC ELECTRIC. GENERAL DESCRIPTION. James N. Kilpatrick (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 466-8(1960) Oct.

A description is given of the Yankee Atomic Electric plant at Rowe, Mass. The reactor is closed-cycle light-water cooled and moderated and uses enriched UO_2 pellets encased in stainless steel. The reactor is controlled by means of Ag-In-Cd rods. A supplementary chemical control system based on boron injection is provided to ensure cold shut-down should this prove necessary. To prevent bulk boiling of the coolant, a saturation overpressure is always maintained. Low-level liquid wastes are discharged into the river after dilution. Gaseous waste, after suitable dilution with fresh air, is dispersed into the atmosphere in small quantities under favorable meteorological conditions. An operational radiation monitoring system is provided to detect, compute, and indicate the radiation level at selected locations inside and outside the vapor container. (M.C.G.)

2351

YANKEE REACTOR VESSEL. P. Blair Haga (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 468-70 (1960) Oct.

The reactor vessel is cylindrical with a permanently attached hemispherical bottom head and a removable, spherically dished, top head. Primary coolant water enters the vessel through four inlet nozzles located above the core, passes down through the reflector and thermal shield regions, up through the core, and leaves the vessel through four outlet nozzles located in the same horizontal plane as the inlet nozzles. With the exception of the thermal shield, all internals are supported by a ledge cut in the vessel flange and held in place by the compression loading of the core hold-down ring by the closure head. The thermal shield was designed to reduce thermal stress in the vessel wall and fast-neutron irradiation. The closure head is attached to the vessel with 52 $5\frac{1}{4}$-in. studs. The reactor vessel was designed, fabricated, and tested according to the ASME code. (M.C.G.)

2352

YANKEE INITIAL CORE. Arthur G. Thorp, II (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 470-2 (1960) Oct.

The core can be approximated to a right circular cylinder 75.4 in. in diameter and 91.86 in. high. It consists of 76 vertical fuel assemblies, 24 control rods, and 8 fixed shim rods. The basic fuel assembly is composed of stainless-steel tubes that contain enriched UO_2 in the form of ceramic pellets. The reactor control rods are cruciform in shape and fabricated from a Ag-In-Cd alloy. The core structure consists of an upper and a lower core support plate, an upper and a lower support barrel, and a baffle structure. The neutron source consists of both Po-Be and regenerative Sb-Be sources. The design data are given in tables. (M.C.G.)

2353

YANKEE CONTROL ROD DRIVE MECHANISM. Thomas F. Widmer (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 472-4(1960) Oct.

Control rods in the Yankee core are operated by a set of 24 drive mechanisms mounted on the vessel head. Design of the mechanisms is based on the magnetic-jack principle, which provides the advantage of hermetic closure for the primary system. A schematic diagram is included of the drive mechanism. Reliable scram is assured by conservative selection of tooth and linkage geometry in the latch assemblies. A spring is provided at each latch magnet armature to assure quick return of the latch mechanism during normal cycling. The operation of the mechanism depends on the magnetic flux forced through the walls of a thick pressure shell. (M.C.G.)

2354

YANKEE REACTOR CONTROL SYSTEM. Clovis F. Obermesser (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 474-5(1960) Oct.

The reactor control system provides for manual or automatic control of the reactor, control switching of 24 latch type rod mechanisms, and two separate means of rod-position indication. The servo-control portion of the sys-

tem provides manual or automatic control for an essentially constant average temperature maintained on a steady-state basis. A positive column type indication is given of each control-rod position. Reactor flux monitoring from source to 150% of the designed full-power output is provided by nuclear instrumentation. (M.C.G.)

2355

YANKEE FUEL HANDLING. Harley A. Smith (Westinghouse Electric Corp., Pittsburgh). Nuclear Eng. 5, 476 (1960) Oct.

Fuel-handling facilities include means for underwater removal of spent fuel assemblies and control rods and a system for transferring such spent assemblies from inside the vapor container to the external storage pit. New fuel, as it is received, is stored in a dry vault adjacent to the spent-fuel pit. The safe continuity of underwater transfer of fuel and control rods is maintained by an inclined transfer chute between the shield-tank cavity and the spent-fuel transfer pit. During refueling operations, the reinforced concrete, stainless-steel-lined shield-tank cavity is filled to a depth of approximately 25 ft with borated water. (M.C.G.)

2356

STEAM CYCLES FOR POWER REACTORS. [PART] 2. W. J. Thomas and R. A. Lorge (Kennedy and Donkin, [London]). Nuclear Power 5, No. 54, 88-91(1960) Oct.

The problem of excess terminal-steam wetness due to high pressures used in attempts to increase steam-cycle efficiency is discussed. Regenerative feed heating improves efficiency, but not in nuclear stations working at low pressures. The steam pressure can be adjusted by rearranging the heating surfaces in the steam-raising unit. Superheating of low- and high-pressure steam increases efficiency while avoiding excess steam wetness. Various means are available for reducing steam wetness, e.g., internal drain boards and grooved turbine blades, and the type of expansion that can be obtained in this way is illustrated as a Mollier diagram for the Dresden BWR turbine fitted with grooved blades. Reheat of high-pressure steam is used in the Dungeness and Tokai-Mura reactors. The integral nuclear steam generator, patented 5 years ago, is discussed. The PWR and BWR are discussed with respect to advantages and disadvantages of secondary circuits and heat exchangers. Externally fired super- and re-heaters (hybrid stations) are discussed, but they are not worth while in comparison with reactors having higher reactor-coolant temperatures. Some of the operating conditions are given for the advanced high-temperature gas-cooled reactors giving 930 to 2400°F coolant-outlet temperatures. Reactors using nuclear superheating of the working steam in the core are now in the design or building stage (Borax V, Bonus, Pathfinder, Vickers Marine, and Ural), and some of their operating conditions are given. A combined flow and heat-steam diagram is shown for the Vickers Marine reactor which has a thermocompressor in place of coolant circulators. If these reactor projects are successful, large nuclear stations in the 1970's can be expected to approach the steam cycles of conventional stations. (D.L.C.)

2357

BREEDER ECONOMICS. Jack Chernick (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng. 8, 365 (1960) Oct.

In a study of U. S. uranium reserves, the great differences in reserves of high-grade and low-grade ores made it clear that prices must be included in any discussion of nuclear fuel. Reserves of high-grade uranium are sufficient to develop a large scale commercial power industry, but insufficient to sustain it in the absence of a breeder economy. The depletion of both economically recoverable fossil fuels and low-grade uranium at low fuel utilization is expected after a period of several decades. It is postulated that during this period a breeder economy based on uranium and thorium ores in this price range must be established to prevent an excessive rise in fuel costs. (M.C.G.)

2358

THE ANALYSIS OF THERMAL ECONOMY OF ATOMIC POWER PLANTS, ARRANGED WITH A GAS COOLANT. L. S. Sterman, V. V. Petukhov, V. P. Protsenko, and A. V. Chikilevskaya (Moscow Inst. of Power Engineering). Teploenergetika 7, No. 9, 6-12(1960) Sept. (In Russian)

Techniques for analyzing the thermal economy of gas-cooled (carbon dioxide at 15 atm) nuclear power plants are suggested. Analyses are carried out at 300, 375, and 400°C gas inlet temperatures for a two-cycle steam generator and at 375°C for a single-cycle generator. The economy factor and efficiency of the two systems are compared. (tr-auth)

2359

AN APPROXIMATED METHOD OF ANALYTICAL DETERMINING INITIAL, OPTIMAL PARAMETERS OF POWER PLANTS ARRANGED WITH GAS COOLANT. V. P. Protsenko (Moscow Inst. of Power Engineering). Teploenergetika 7, No. 9, 13-18(1960) Sept. (In Russian)

Analytical expressions are developed for gas-cooled nuclear power plant efficiency factors related to maximum fuel-element temperature and coolant parameters. Formulas are derived for approximately determining optimum power levels, considering the economic aspects of coolant pumping. (tr-auth)

2360

PROBLEMS OF NUCLEAR POWER PLANTS WITH WATER, STEAM AND WATER, AND STEAM REACTOR COOLANTS. T. Kh. Margulova (Moscow Inst. of Power Engineering). Teploenergetika 7, No. 10, 3-5(1960) Oct. (In Russian)

Problems arising in the construction of one- and two-cycle power plants are discussed, and comparisons are made of the principle features and efficiencies of various reactors with water, steam-water, and steam coolants. (R.V.J.)

2361

DYNAMIC VERSUS DIRECT CONVERSION. Ken Johnson (Aerojet-General Nucleonics, San Ramon, Calif.). Paper No. 1321-60. Presented at the ARS Space Power Systems Conference, Santa Monica, California, September 27-30, 1960. New York, American Rocket Society, 1960. 27p.

The performance capabilities of advanced nuclear dynamic and nuclear direct conversion space electric power plants are compared on a lb/kw basis. A dynamic conversion plant which uses potassium as a working fluid at a turbine inlet temperature of 1900°F and exhaust temperature of 1300°F is considered. The specific weight of such a plant is estimated to range from 12.5 to 8.5 lb/kw at a power level of 300 to 2000 kw(e). The state of the art of thermoelectric conversion is reviewed, and it is concluded that because of limited temperature potential thermoelectrics are not competitive at high power levels. The potential of thermionics with the converters located in the reactor is analyzed. In the thermionic system, fuel pins are used as cathodes and the anodes are cooled by a circulating coolant flowing through the radiator. A theoretical analysis (e = 0.5) indicated that the thermionic concept is

competitive with the dynamic system when cathode current densities of 10 amp/cm^2 are attained. An analysis of a uranium carbide ZrC reactor (e = 0.8) (using LASL experimental data) indicated that it becomes competitive with the dynamic system when a cathode power density of 30 watts/cm^2 is attained. No attempt is made to evaluate the feasibility, lifetime, or reliability, or the development problems inherent in both dynamic and thermionic concepts. (auth)

2362

STABILITY AND CONTROL OF NUCLEAR ROCKET PROPULSION. Ronald R. Mohler (Los Alamos Scientific Lab., N. Mex.). IRE Paper No. 60AC-8. Presented at the Joint Automatic Control Conference, Cambridge, Massachusetts, September 7-9, 1960. New York, Institute of Radio Engineers, 1960. 11p.

A systems treatment of the dynamic behavior of nuclear rocket propulsion systems is presented. This simplified analysis does represent the basic ideas of more detailed computer studies. Nuclear reactor systems for space propulsion are much faster than conventional reactor systems which complicates the controls problem. (The dynamics of chemical systems were simpler in nature owing to their speed of response.) One attractive solution, which uses the propellant reactivity, is discussed. (auth)

Research Reactors

2363 IDO-16625

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

SIMULTANEOUS NON-DESTRUCTIVE ANALYSIS OF ETR FUEL CORE SAMPLES FOR BORON AND U^{235}. D. W. Knight and E. Fast. Apr. 7, 1959. 24p. Contract AT(10-1)-205. OTS.

Reactivity Measurement Facility (RMF) analyses of 33 samples from 17 Engineering Test Reactor (ETR) fuel core melts showed an average boron content of 0.116 wt. % or about 20% above that specified for the ETR fuel elements. Duplicate samples from the same melts differed by 43.1% of their mean value on an average indicating a nonuniform distribution of boron. The procedure developed for these analyses illustrates that the RMF can be used in the analysis for fuel and poison materials on small samples in the absence of uniform geometry and calibration standards of the same type. (auth)

2364 NP-9300

Lockheed Nuclear Products, Marietta, Ga.

NEUTRON SPECTRAL MEASUREMENTS OF THE RADIATION EFFECTS REACTOR LEAKAGE FLUX. J. H. Wilson, H. H. Nichols, J. K. Grant, and T. W. Ponder. Aug. 1960. 49p. Contract AF33(600)-38947. (NR-100)

Neutron leakage flux spectral measurements were made in large air volumes surrounding the Radiation Effects Reactor using foil activation techniques. The subcadmium, resonance, and fast-neutron flux components were determined. (C.J.G.)

2365

PROGRESS AT WINFRITH ATOMIC ENERGY ESTABLISHMENT. Engineer 210, 490-3(1960) Sept. 23.

An outline is presented of the current research-reactor projects at the Atomic Energy Establishment of Winfrith, Dorset. The reactors described in some detail are the Zenith, exponential stack, differentially heated graphite assembly, fine-structure experiment, Scorpio I and II, Hector, Nero, Helen, and Zebra reactors. (D.L.C.)

2366

SECOND YEAR OF WWR-S-REACTOR EXPLOITATION IN POLAND. J. Aleksandrowicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika 5, 385-414(1960). (In Russian)

A short review is given of experiences gathered during two years of WWR-S reactor operation. Various reactor experiments are described. Some remarks on the possibilities of adaptating the reactor to experiments in the field of radiation chemistry are quoted. The results of the following measurements are given: change of build-in reactivity during operation, burn-up, analysis of cooling water in the primary circuit, the radiolysis of cooling water, temperature distribution and heat removal measurements in the thermal column, and possibilities of increasing of reactor power. Advances in radiation protection, control, and safety instrumentation are given. Some experiences in production of radioisotopes are described. (auth)

2367

REACTORS FOR RESEARCH AND TESTING OF MATERIALS. Jean Le Chatelier. Paris, Société des Ingénieurs Civils de France, [1960]. 12p. (In French)

The French research and materials testing reactor program is surveyed. Melusine, Triton, EL-3, and Zoe (EL-2) are discussed. Future projects are mentioned, including Pégase and Cadarache. European cooperation (AIEA, OECE, and Euratom) is also discussed. (T.R.H.)

WASTE DISPOSAL AND PROCESSING

2368 AFSWC-TN-60-25

Air Force Special Weapons Center, Kirtland AFB, N. Mex.

THE FEASIBILITY OF USING REMOTELY CONTROLLED VEHICLES TO DECONTAMINATE LARGE PAVED AREAS. Clayton L. Schlemm and Alexander E. Anthony, Jr. Oct. 1960. 96p. Project No. 7806.

Studies were performed to determine the feasibility of using a remotely controlled vehicle to sweep and remove radioactive debris from large paved areas. Test data were collected for comparison of the remote operation and manual operation of the vehicle. The test parameters included comparison of decontamination efficiency, time needed for decontamination, and sweeping patterns. A comparison of test parameters indicated that it is feasible to use a remotely controlled sweeper to decontaminate an area. Approximately the same decontamination efficiencies were obtained under remote and manual operation (approximately 99.7%). The operating time for remote decontamination was about twice that for manual. This time can be reduced as the area to be swept becomes larger and the operator becomes more proficient. These results were obtained on a small area (approximately 3000 sq ft). The time lost was mostly in turning around and reorienting the vehicle at the end of each sweeping pass on the contaminated area. (auth)

2369 CF-60-4-66

Oak Ridge National Lab., Tenn.

DESIRABILITY OF CHEMICAL DECLADDING FROM THE WASTE DISPOSAL VIEWPOINT. A. R. Irvine. Apr. 1, 1960. 12p. OTS.

Chemical decladding of stainless-steel- and Zircaloy-jacketed fuel elements is discussed relative to cladding activation and waste-disposal cost as compared with a total dissolution process. (C.J.G.)

2370 HW-61644(Rev.)
General Electric Co. Hanford Atomic Products Operation, Richland, Wash.
TECHNIQUES FOR ESTIMATING THE SPECIFIC RETENTION PROPERTIES OF HANFORD SOILS. W. H. Bierschenk. Aug. 20, 1959. 38p. Contract AT(45-1)-1350. OTS.

The specific retention capacity of a soil varies with the period of draining, with the size of the sample, and with soil characteristics such as the average grain size. It is recognized that mechanical analyses permit only a qualitative description of the soil and are useful chiefly for comparison purposes. Data were obtained which indicate that the natural moisture content of certain Hanford soils in the field may be satisfactorily reproduced by draining a 1-cm thick sample of soil from the same horizon at 1000 gravities for 1 hr in a centrifuge. This empirical test was applied to samples from geologic horizons having a natural moisture content ranging from <1 to about 18% (in an isolated silt lens) moisture by volume. The average ratio of the natural field moisture content to that defined after centrifuging saturated samples ranged from 0.82 to 1.06, indicating good reproduction of the natural moisture content by the centrifuge drainage technique. Assuming that this moisture content represents equilibrium-specific retention after extruded drainage, the specific retention capacity of columns of soils beneath 200-West Area was estimated to be roughly 2% by volume whereas beneath 200-East Area it was estimated to be less than 1%. Tersaghi's equation ($t_1 = N^2 \bar{t}$), which theoretically relates drainage time and the gravitational force applied to achieve a given drainage, was tested. The results averaged about 7% by volume for certain columns of soils beneath 200-West Area and about 3% for 200-East Area for drainage periods of 30 years at 1 gravity. (auth)